WAR PLANES OF THE SECOND WORLD WAR

BOMBERS

AND RECONNAISSANCE AIRCRAFT

VOLUME SEVEN

WILLIAM GREEN

BOMBERS AND RECCE ACFT. VOL. 7

DOUBLEDAY

$3.50

WAR PLANES OF THE SECOND WORLD WAR

by

William Green

Volume VII

BOMBERS AND RECONNAISSANCE AIRCRAFT

Volume Seven is the first in a series of volumes to be devoted to land-based aircraft employed during the Second World War for bombing, reconnaissance or army co-operation, irrespective of age or importance, as well as those aircraft that were being actively developed for such tasks by the various combatants during 1939–1945.

Cover illustrations (top to bottom): The first production Commonwealth CA–11 Woomera (1944), a Bloch 174 A3 of the *Armée de l'Air Groupe de Reconnaissance* II/33 (Athiés-sous-Laon, 1940) and a Breguet 695 AB2 of the *Groupe de Bombardement d'Assaut* I/51 (*Lézignan*, 1942).

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With Drawings by Dennis I. Punnett

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INTRODUCTION

In the three years immediately preceding the Second World War the normal metamorphosis in combat aircraft design was accelerated to an unprecedented degree. Lessons being gleaned from the Spanish Civil War, coupled with a markedly increased tempo in technical evolution engendered by the approaching clouds of a more widespread conflict, radically changed the war plane in every category, both in appearance and capability, and none more so than the bomber in its multifarious forms.

Widely divergent schools of thought existed, of course, concerning both the role and the form that the bomber should take. The conventionalists insisted that the bomber should rely on heavy defensive armament to protect it from the opposing interceptor; the visionaries protested that given sufficient speed the bomber could elude the interceptor entirely. There was hesitancy between carrying a small load quickly and a large load far; the proponents of strategic bombing vied with those of tactical bombing for priority in development funds. But large or small, the bombers that began to emerge in the late 'thirties bore little resemblance to their predecessors of a few short years earlier.

In no major aircraft-manufacturing country was this change more marked than in France, whose war plane progeny occupy more than half of this volume. French aircraft designers had displayed a quite astonishing propensity towards angularly ugly monstrosities of bombers; ponderous war planes making few concessions to the demands of aerodynamic cleanliness. Yet, by the late 'thirties, these ungainly creations were giving place to bombers which, by standards of the day, offered the very quintessence of aerodynamic elegance.

Unfortunately for France's *Armée de l'Air*, these new bombers, although to be compared with the finest extant, attained quantity production too late to affect to any marked degree the issue when Germany began her offensive in May 1940, and the bulk of that service's first-line combat elements found themselves either immersed in conversion programmes or equipped with bombers so obsolete as to possess little chance of survival in the skies over France.

But the *Armée de l'Air* was by no means alone in possessing a preponderance of obsolete or, at least, obsolescent bombers during the opening phases of the conflict. The smaller air arms that were soon to become involved were, of course, ill-equipped for the type of aerial warfare by which they were to be faced, their bombing elements having enjoyed less than their share of their countries' budgets. But some of the bombers entering service with the larger air arms when hostilities began possessed a measure of built-in obsolescence resulting from the short-sightedness of those responsible for framing the specifications to which they had been evolved.

Much the same may be said for reconnaissance and army co-operation aircraft which share with bombers the pages of this volume. Neglected for so many years—years in which such war planes were invariably aircraft designed at the outset for roles far removed from that of observing terrestrial activity—they only began to come into their own shortly before the Second World War when the vital importance of aerial reconnaissance began finally to be appreciated.

But the Second World War had many fronts, and conditions existed over some of these that permitted, for a time at least, the operation of bombers and reconnaissance aircraft that would have been hard put to survive a single sortie elsewhere. Thus, the aircraft described

and illustrated by this volume of *War Planes of the Second World War* offer many strange and surprising contrasts, ranging as they do from war planes fully representative of the state of the art when war began, through the obsolescent to the totally obsolete; aircraft which, in some cases, would have appeared less out of place in the First World War than in the Second.

Examples of such totally obsolete aircraft to be found in the pages that follow include the Blackburn Ripon of the 'twenties which soldiered on in Finnish service until the termination of hostilities; the Fairey Fox, which, also conceived in the 'twenties, flew a major proportion of the operational sorties undertaken by Belgium's *Aéronautique Militaire*, and the only slightly more youthful Letov Š–328 resurrected by the *Luftwaffe* for use by that service's *Störkampfstaffeln* when these were created in the winter of 1942–43.

These venerable biplanes may at first sight appear odd companions for such advanced war planes as the pressurized NC 150 high-altitude bomber, the Bloch 175, and other examples of the last pre-1940 generation of French bombers and reconnaissance aircraft, as must also such types as the Canadian Vickers-built Northrop Delta intended for a more pacific role than that of armed coastal reconnaissance forced upon it by the exigencies of the times, but the task of *War Planes of the Second World War* is to record *all* combat aircraft that were actually under active development or construction during the war years, or saw active service irrespective of their age or degree of obsolescence.

War Planes of the Second World War Volume Seven follows closely the pattern established by previous volumes in this series, but since Volume Six was published five years ago, I have received a considerable number of requests from readers to provide more details of the operational careers of the aircraft described, and I have endeavoured to fulfil these in this and subsequent volumes.

I can claim with every justification that much hitherto unpublished information is to be found in the pages that follow, and that many errors of fact perpetrated in the past and perpetuated since have finally been corrected, and in this connection I should like to record my gratitude to Robert Gollier, Guy Destrebecq, Patrick Gardiner, Zdenek Titz, Vaclav Nemecek, Colonel K. W. Janarmo, Eino Ritaranta, Doctor Giovanni Caproni di Taliedo, the historical sections of France's *Armée de l'Air* and *Marine Nationale*, the personnel of the Nord-Aviation, Sud-Aviation, Breguet and Latécoère concerns, and finally to my two good friends, Pierre Leyvastre and Dennis Punnett, the former for his indefatigable researches over the years into the history of French aviation, and the latter for his resolute attention to detail accuracy in the preparation of the general arrangement drawings which form so important a part of this book.

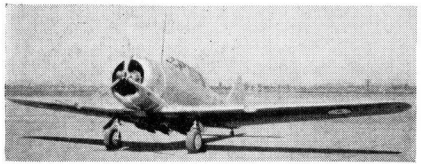
London, August 1967 William Green

COMMONWEALTH WIRRAWAY AUSTRALIA

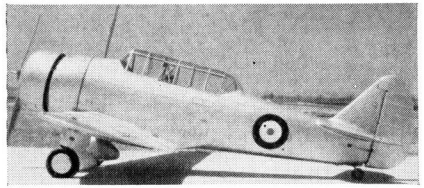
Although essentially a training aircraft, the Wirraway was to experience almost as eventful and dramatic an operational career as any warplane of World War II. Indeed, time was to prove that few aircraft had ever been more appropriately named, for Wirraway was an aboriginal word meaning "Challenge", and on numerous occasions Wirraways, out-performed, out-gunned and outnumbered, were to challenge Japanese aerial superiority. Such were its exploits that it was to become the most famous of all Australian aircraft. The Wirraway's use in operational roles was considered at the outset a temporary expedient; such was the temporariness of the expedient that some Wirraways were still in first-line service in 1945 when the Pacific War ended.

When production of the Wirraway was initiated at Fishermen's Bend, Melbourne, in 1938, its manufacturer could scarcely have envisaged that, within a few years, its tasks would have ranged from dive-bombing and low-altitude strafing to tactical reconnaissance, target marking, supply dropping and general army co-operation duties. In fact, the Wirraway was to be employed on occasions even as an interceptor fighter, although it would be idle to suggest that is was *successful* in this or, for that matter, several of the other roles that it was called upon to perform as a matter of expediency. But the Wirraway's activities, particularly during army co-operation duties in

Three CA-1 Wirraways (A20–21, –22 and –23) of No. 21 Squadron which served in Malaya. A camera gun may be seen mounted above the port wing root



(Above) The North American NA-33 (NA-16-2K), precursor of the Wirraway, and (below) the NA-32 (NA-16-1A) which was similar apart from its airscrew and undercarriage



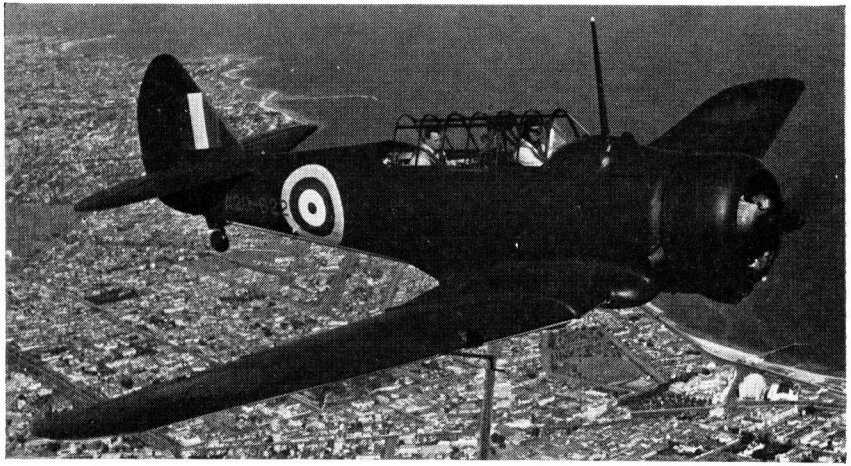
Borneo, the Solomons and New Guinea, were to become a part of R.A.A.F. tradition.

The more militant chapters of the Wirraway's career were the direct outcome of the appallingly unprepared state in which the R.A.A.F. found itself when, in December 1941, Japan launched the Pacific War. Possessing few combat aircraft and faced with the possibility of eventual Japanese invasion, the R.A.A.F. was forced to employ the Wirraway for a wide variety of operational tasks for which it was hardly suited, this being the most modern aircraft available in any quantity.

The Wirraway had been the first product of the Commonwealth Aircraft Corporation formed in 1936 by several of the largest industrial concerns in Australia. To gain manufacturing experience, it had been decided to acquire a licence to produce an aircraft suitable both for advanced training and as a replacement for the obsolescent general-purpose Hawker Demons serving with the R.A.A.F. Accordingly, an Air Board Technical Commission visited the U.S.A. and evaluated the North American **NA-16** which, flown as a prototype in April 1935, had been ordered into production for the U.S. Army Air Corps as the BT-9 (NA-19) basic trainer.

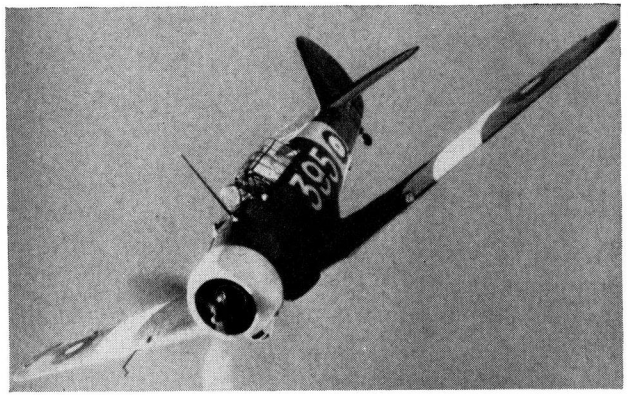
At the time of the Australian Commission's visit, North America was working on a progressive development of the BT-9 which, with a 600 h.p. Pratt & Whitney R-1340 engine in place of the 400 h.p. Wright R-975, a retractable undercarriage and armament provision, was intended to meet the Army Air Corps' new requirement for a "basic combat trainer" with the equipment and attributes of operational aircraft. Designated **NA-26**, this aircraft adequately fulfilled the requirements of the Australian Commission, although there was some disagreement concerning the need or advisability of a retractable undercarriage for the training role. As a result, two versions of the NA-26 were offered the Australians, the **NA-32** (NA-16-1A) with fixed undercarriage, and the **NA-33** (NA-16-2K) with a retractable undercarriage, and in 1937, negotiations for manufacturing rights in both the NA-32 and NA-33 were completed, and an order placed for one specimen example of each type.

The NA-32 was completed in July 1937, although it was not to be taken on charge by the R.A.A.F. until November 8, 1938, and by that time, the NA-33, which had been completed in September 1937 and taken on charge by the R.A.A.F. on February 2, 1938, had already been selected for Australian production. With minor changes to suit it more closely to R.A.A.F. requirements and Australian operating conditions, the NA-33 was ordered for the R.A.A.F. as the **A20**, the Commonwealth Aircraft Corporation, or C.A.C., applying the designation **CA-1** to the type, and the name **Wirraway** being adopted. The initial contract called for 40 CA-1 Wirraways (A20-3 to -42) powered by the Wasp R-1340 S1H1-G nine-cylinder radial of 600 h.p., and the first aircraft on this contract (A20-3) was flown on March 27, 1939, at Fishermen's Bend by Flt. Lt. L. H. Walker.



A CA-9 Wirraway trainer (A20–622), the 619th Wirraway built under the original programme calling for 620 aircraft, and flown in the summer of 1942

The Wirraway's structure comprised a welded chrome-molybdenum steel-tube fuselage with light metal-covered decking and underside, the sides having fabric-covered light-alloy frames; a single-spar wing with spaced ribs and metal stressed-skin covering, and fabric-covered dynamically-balanced ailerons and split trailing-edge flaps, and a tail assembly consisting of metal-covered fixed surfaces and fabric-covered movable surfaces. All fuel was housed in two 46 Imp. gal. tanks in the wing centre section. The main undercarriage members were hydraulically operated, retracting into wells forming extensions of the leading-edge roots. The tandem cockpits were enclosed by sliding canopies, full dual controls were installed, the rear seat could be folded and rotated, and a prone bombing position was provided in the floor. Racks beneath the



The CA-16 dive-bombing variant of the Wirraway had provision for larger external bomb loads, but with maximum offensive load the aircraft was normally flown as a single-seater

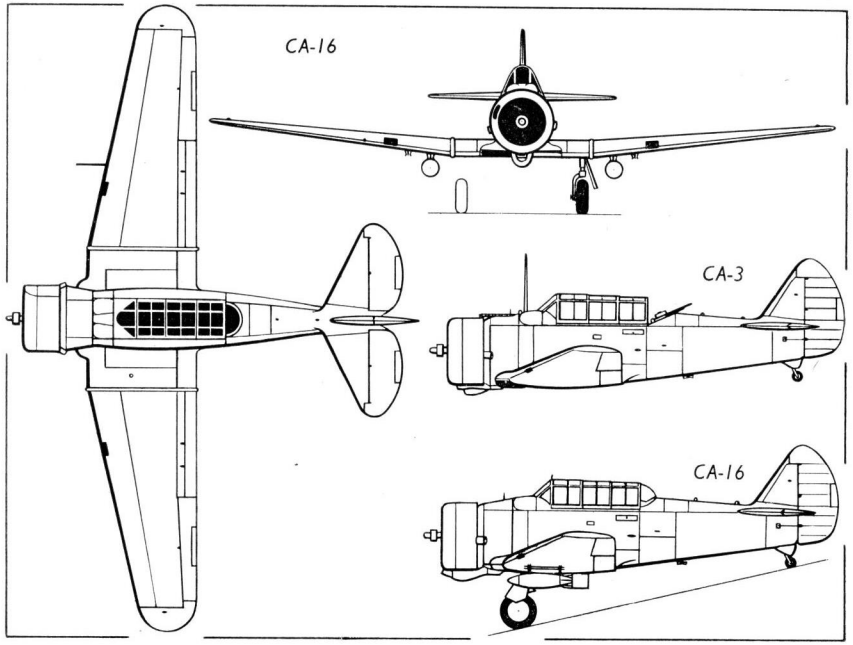
wing centre section could carry 8.5-lb. or 11.5-lb. bombs and marker flares, and provision was made for mounting two 0.303-in. Vickers Mk.V machine guns in the forward-fuselage upper decking, the pilot being provided with a ring-and-bead sight, and a Vickers Mk.1 gun of similar calibre could be mounted in the rear cockpit.

Early Wirraways were powered by imported Wasp S1H1-G engines, but this engine was subsequently licence-built by C.A.C. (680 single-row Wasps eventually being produced), and the three-bladed Curtiss electric controllable-pitch airscrews were produced from 1940 by de Havilland Aircraft at Alexandria, N.S.W.

WIRRAWAY VARIANTS

The initial contract had been supplemented by the spring of 1940 by orders for 60 **CA-3** Wirraways (A20-43 to -102) which differed externally from the CA-1 in having an enlarged oil cooler beneath the engine; 32 **CA-5** Wirraways (A20-103 to -143) embodying minor instrumentation and equipment changes and 100 **CA-7** Wirraways (A20-135 to -234), production attaining a rate of seven per week by the end of 1940. By this time further orders had been placed with the C.A.C., calling for 200 **CA-8** Wirraways (A20-436 to -635) and 188 **CA-9** Wirraways (A20-636 to -823), these each introducing small changes, such as the repositioning of the carburettor air intake, additional wing racks, etc. The original Wirraway programme thus covered a total of 620 aircraft—production rate attaining 45 aircraft per month in September 1941—of which the last was completed in June 1942, but the exigencies of the times had meanwhile resulted in an order for a further 150 Wirraways of the modified **CA-16** version (A20-1075 to -1224) intended for the dive-bombing role, although, in the event, only 135 of these were to be delivered to the R.A.A.F.

Earlier proposals for dive-bombing versions of the Wirraway, the **CA-10** and **CA-10A**, had been cancelled, and the CA-16 differed from the standard Wirraway primarily in making provision for larger external bomb loads, racks being fitted immediately outboard of the wing centre section for two 500-lb. and two 250-lb. bombs which could be carried in addition to the six 8.5-lb. or 11.5-lb. anti-personnel bombs and eight target-markers. The 1,500-lb. increase in offensive load necessitated a concomitant reduction in weight elsewhere, and the twin Vickers guns in the forward fuselage decking and the flexible rear-firing gun were removed, and the aircraft was normally flown as a single-seater when maximum bomb load was carried, although the second seat was retained.



OPERATIONAL SERVICE

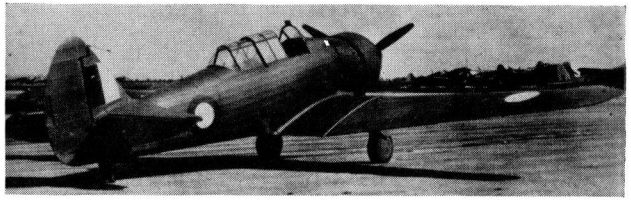
Wirraway deliveries to the R.A.A.F. began in July 1939, and the first units to equip with this type were Nos. 12 and 21 Squadrons. The former Squadron was based at Darwin for patrol and convoy escort tasks from late 1939, and in July 1940, the latter Squadron was despatched to Singapore to aid in the defence of the Malayan Peninsula, subsequently operating from Seletar. No. 21 Squadron was still in Malaya when the Pacific War began, although by that time the unit had re-equipped with the Buffalo fighter, but a detachment of six Wirraways from No. 12 Squadron was operating in the advanced training role in Malaya at the time of the Japanese invasion, and raised to operational status, these subsequently performed dive-bombing and strafing sorties against enemy landing barges and ground positions.

On December 7, 1941, there were seven first-line Wirraway-equipped squadrons on R.A.A.F strength, these being No. 4 Squadron at Canberra, No. 5 Squadron at Laverton, No. 12 Squadron at Darwin (with a detachment at Kahang, Malaya), No. 22 Squadron at Richmond, No. 23 Squadron at Archerfield, No. 24 Squadron at Townsville, and No. 25 Squadron at Pearce. No. 24 Squadron was immediately despatched to Vunakanau, Rabaul, providing the only *fighter* defence when, from January 4, 1942, Rabaul came under Japanese attack. Two days later, on January 6th, a Wirraway from No. 24 Squadron gained the distinction of becoming the first R.A.A.F. aircraft to engage in aerial combat in the South-West Pacific when it intercepted a Kawanishi H6K4 flying boat reconnoitring Rabaul, but it was on January 20th that the Wirraway participated in a truly epic battle. On this occasion a force of 120 Japanese aircraft attacked Rabaul, promptly being intercepted by two of No. 24 Squadron's Wirraways that had been on standing patrol. These were joined by five more Wirraways, but the strong escort of Mitsubishi A6M2 Zero-Sen fighters made short work of the defending force which fought a gallant but hopeless battle in which three Wirraways were shot down and two more irreparably damaged.

Japanese air attacks on Darwin began on February 19, 1942, a total of 66 attacks being made over the next 20 months on this city, Broome, Wyndham, and other northern Australian towns, and during the first five months of this period only the Wirraways of No. 12 Squadron were available for defence. Fortunately, as Kittyhawks began to reach the R.A.A.F. in numbers, the Wirraways were allocated other but none-the-less hazardous tasks than interception, No. 12 Squadron itself being reorganised as a dive-bomber unit, its Wirraways serving until finally supplanted by Vengeances in April 1943.

The Wirraway was soon serving in the low-level ground strafing role, as a pathfinder for other aircraft types, attacking enemy land bases and shipping, and acting as the "eyes" of both Army and Navy on co-operation work in New Guinea, New Britain and the Solomons. No. 4 Squadron's Wirraways were despatched to Port Moresby in November 1942, subsequently operating from Berry and various other airstrips as detached flights. The sorties of No. 4 Squadron's aircraft were to become legendary, including continuously hair-raising strafing and harrying missions under the noses of enemy fighter pilots, the skilful Australians evading the faster Japanese aircraft by flying along narrow valleys and between trees, the Wirraways often returning to their airstrips riddled with small-arms fire and with branches embedded in their wings, providing eloquent testimony to the sturdiness of the aircraft's structure.

Flying Officer J. S. Archer of No. 4 Squadron gained the distinction of shooting down a



The 35th production CA-16 Wirraway (A20-657). A further 100 examples of the CA-16 model were subsequently built, but few of these were used in the dive-bombing role for which this version was originally intended

Zero-Sen fighter while flying a Wirraway over Gona on December 26, 1942, and in February 1943, the Wirraways of this unit played a vital part in combating the Japanese push down the Wau valley, at one time operating under point-blank fire from the Japanese who had penetrated to within a 100 yards of the airstrip. Later in 1943, No. 4 Squadron began to receive Boomerangs but the faster single-seater never actually replaced the Wirraway, and from September 1943, Boomerangs and Wirraways acted in concert, the single-seaters providing top cover for Wirraways operating at minimum altitude. On Bougainville, No. 5 Squadron, with a mixture of Wirraways and Boomerangs, served as target-markers for R.N.Z.A.F. Corsairs, but for a considerable time prior to this the Wirraways of Nos. 5, 23 and 24 Squadrons had performed the more mundane role of anti-submarine patrol in the Eastern Area, No. 25's Wirraways performing similar functions in the Western Area.

Although the Wirraway was to remain in first-line operational service until the end of the Pacific War, it had largely been supplanted by mid-1943, by which time more suitable combat types had become available, and it was progressively relegated to the less glamorous task of basic training with the E.A.T.S. as well as with several Operational Training Units, the 755th and last Wirraway manufactured by C.A.C. being finally completed in June 1946.

COMMONWEALTH WIRRAWAY SPECIFICATION

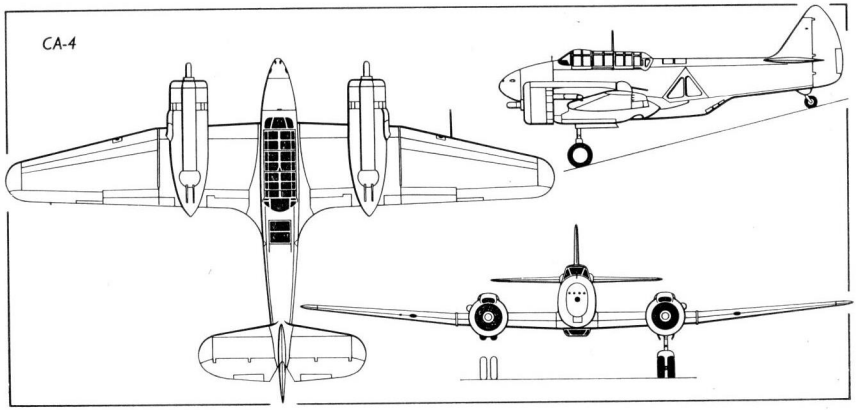
Type: *Tandem Two-seat Light Bomber, Tactical Reconnaissance and Army Co-operation Aircraft and Single-seat Dive-bomber.* **Power Plant:** *One C.A.C.-built Pratt & Whitney Wasp R-1340 S1H1-G nine-cylinder radial air-cooled engine rated at 600 h.p. for take-off and 600 h.p. at 6,200 ft.* **Armament:** (*Optional for CA-1, -3, -5, -7 and -9*) *Two fixed forward-firing 0.303-in. Vickers Mk.V machine guns plus one 0.303-in. Vickers Mk.I machine gun on flexible mounting in rear cockpit, and three 100-lb. bombs or twelve 8.5-lb. or 11.5-lb. bombs and eight marker flares, or* (CA-16) *two 250-lb. and two 500-lb. bombs.* **Performance:** *Maximum speed (clean at 6,350 lb.), 220 m.p.h. at 5,000 ft.; cruising speed, 182 m.p.h. at 5,000 ft.; range, 720 mls. at 164 m.p.h.; initial climb rate, 1,950 ft./min.; service ceiling, 23,000 ft.* **Weights:** *Empty, 3,992 lb.; loaded, 6,595 lb.* **Dimensions:** *Span, 43 ft. 0 in.; length, 27 ft. 10 in.; height (excluding radio mast), 8 ft. 8¾ in.; (including radio mast), 12 ft. 0 in.; wing area, 255.75 sq. ft.*

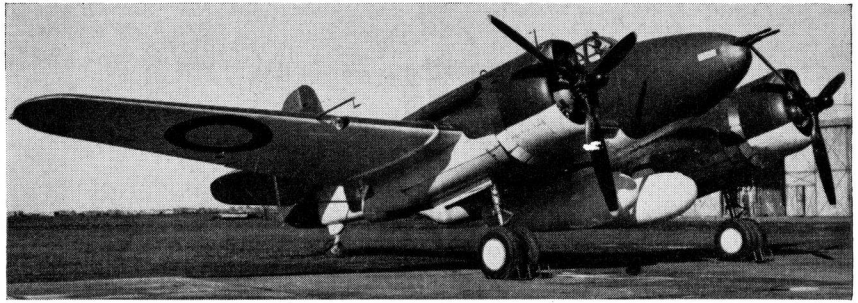
COMMONWEALTH WOOMERA

AUSTRALIA

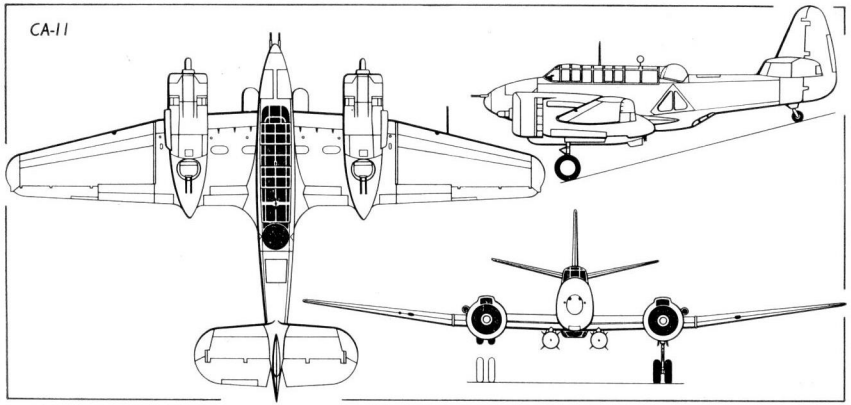
In mid-1939, the Australian government had reached agreement with the British government for the manufacture of the Bristol Beaufort torpedo-bomber and general reconnaissance aircraft in Australia, and the fledgeling design staff of the Commonwealth Aircraft Corporation immediately began work on a potential successor, the **CA-4** Woomera. Powered by two Pratt & Whitney Twin Wasp R-1830 S3C3-G 14-cylinder two-row radials rated at 1,200 h.p. for take-off, the three-seat CA-4 embodied several interesting design features, one of the most intriguing being the provision of remotely-controlled barbettes each housing two 0.303-in. Browning machine guns at the rear of the engine nacelles, above the wing, these being operated by the observer. In addition to housing the aft-retracting twin-wheel main undercarriage members, the engine nacelles also served as weapons bays, each accommodating two 250-lb. bombs which hung on each side of the mainwheel leg. In addition to the barbette-mounted guns, the CA-4 had provision for a battery of four fixed forward-firing 0.303-in. weapons in the nose, and a Vickers K gun could be swung out and fired aft from a ventral step.

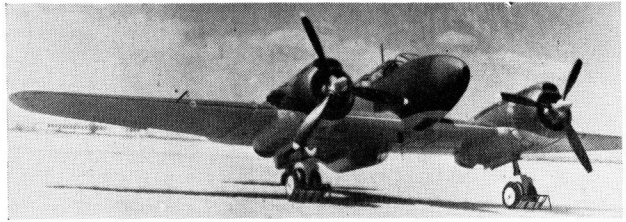
The wing, tailplane and vertical fin of the CA-4 were all-metal, stressed-skin structures. The fuselage comprised a welded chrome molybdenum steel-tube structure covered by plywood panels, and a light alloy nose cone. All control surfaces were metal-framed and fabric-covered, and dive brakes were fitted to the trailing edges of the wing centre section and outer panels. The CA-4 flew for the first





The sole production Woomera, the CA-11 (A23–1), photographed shortly after its initial flight in July 1944, and prior to the introduction of 12° dihedral on the horizontal tail surfaces. Two 293 Imp. gal. drop tanks are seen mounted





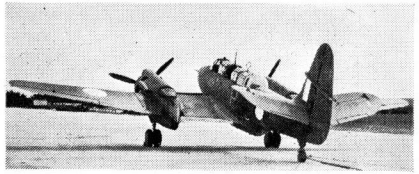
The CA-4 Woomera, the first Australian bomber of indigenous design, was flight tested for some 15 months

time on September 19, 1941, by which time it had been allocated the R.A.A.F. designation **A-23**. Although initial trials revealed some handling shortcomings, in 1942 the Commonwealth Aircraft Corporation received an initial production order for 20 examples of an extensively modified version, the **CA-11**.

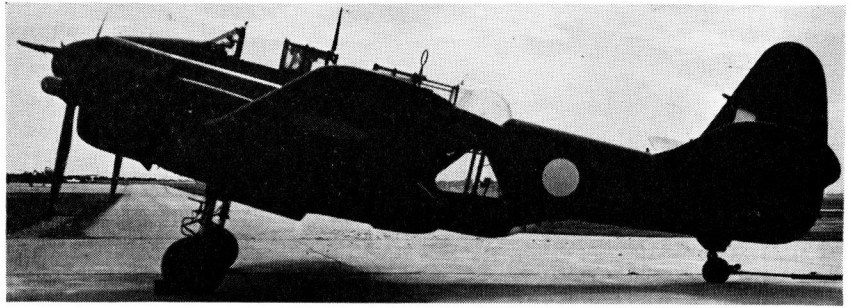
By comparison with that of its predecessor, the wing of the CA-11 featured a broader chord centre section and markedly increased dihedral on the outer panels. The horizontal tail surfaces were enlarged, as were also the vertical surfaces, the aft fuselage upper decking was cut down, and the length of the "glasshouse" enclosing the cockpits was almost doubled. Nose armament was changed to two 20-mm. cannon and two 0.303-in. machine guns, and offensive loads in addition to the four 250-lb. bombs in the engine nacelle bays could comprise four 500-lb. bombs or two 21-in. torpedoes, plus eight 25-lb. bombs under the outboard wing panels. To supplement the wing tanks, which had a total capacity of 596 Imp. gal., one or two 293 Imp. gal. auxiliary fuel tanks could be carried under the centre section in place of the torpedoes or 500-lb. bombs.

The first production CA-11 Woomera (A23-1) flew on July 7, 1944, the sole CA-4 having, in the meantime, crashed while under test near Kilmore in January 1943. Initial trials with the CA-11 were successful, although some buffeting of the tailplane as a result of turbulence generated by the gun barbettes necessitated the application of 12 degrees of dihedral to the horizontal tail surfaces at an early stage in the test programme. However, in September 1944, two months after the CA-11 Woomera's first flight, the entire CA-11 programme was cancelled, it being reasoned that the Japanese were no longer in a position to attempt to regain the offensive, and that adequate numbers of B-25 Mitchell and A-20G Havoc bombers would be available to fulfil the R.A.A.F.'s need long before the Woomera could be delivered in service quantities.

At the time of the cancellation, the second production Woomera was virtually complete, and this, known as the CA-11A, was intended to receive two Pratt & Whitney R-2000 14-cylinder two-row radials of 1,350 h.p. The R-2000, a development of the R-1830 series but of slightly bigger capacity, with new cylinders of increased bore, was to have been manufactured under licence by C.A.C., and was offered as an alternative to the R-1830 in the production Woomera. With the cancellation of the CA-11 contract, the one completed example, together with the uncompleted airframes, was disposed of as surplus.



The CA-11 Woomera (A23-1) photographed after the application of 12° dihedral to the tail. The photograph above right shows the remotely-controlled gun barbettes



COMMONWEALTH CA-11 WOOMERA SPECIFICATION

Type: *Three-seat Torpedo-bomber, Attack-bomber, Dive-bomber and General Reconnaissance Aircraft.* **Power Plants:** *Two Pratt & Whitney Twin Wasp R-1830 S3C3-G 14-cylinder two-row radial air-cooled engines each rated at 1,200 h.p. for take-off and 1,200 h.p. at 3,700 ft.* **Armament:** *(Fixed forward-firing) Two 20-mm. Hispano cannon and two 0.303-in. Browning Mk.II machine guns, plus two 0.303-in. Browning guns in each of two remotely-controlled barbettes, and one hand-held 0.303-in. Vickers "K" gun in ventral position. (Offensive loads) Four 250-lb. bombs in engine nacelle bays, eight 25-lb. bombs under outboard wing panels, and two 21-in. torpedoes, four 500-lb. bombs, or one torpedo and two 500-lb. bombs beneath the centre section.* **Performance:** *Maximum speed (clean), 282 m.p.h., (with two 21-in. torpedoes), 273 m.p.h.; maximum range (with one 293 Imp. gal. auxiliary tank and one torpedo), 2,225 mls.; initial climb rate (clean), 2,090 ft./min., (with external stores), 1,750 ft./min.; absolute ceiling, 23,500 ft.* **Weights:** *Empty, 12,756 lb.; max. loaded, 22,287–22,885 lb.* **Dimensions:** *Span, 59 ft. 2½ in.; length, 39 ft. 7 in.; height (tail up), 18 ft. 2 in.; wing area, 440 sq. ft.*

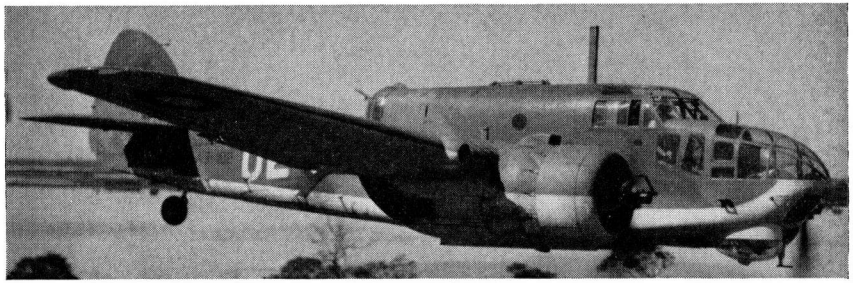
There is no doubt an element of truth in the claim that had effort been placed behind the development and expansion of the Australian aircraft industry when Japan's territorial aspirations first manifested themselves, the Pacific War could well have taken a very different course during its opening stages. But hindsight is no substitute for foresight, and it is historical fact that a start in building a first-line combat aircraft in Australia was not made until the latter half of 1939, when the Sino-Japanese War had been raging for two years, and that two more years were to elapse before the first production example of this aircraft, the Bristol Type 152 Beaufort, was to roll from an Australian assembly line.

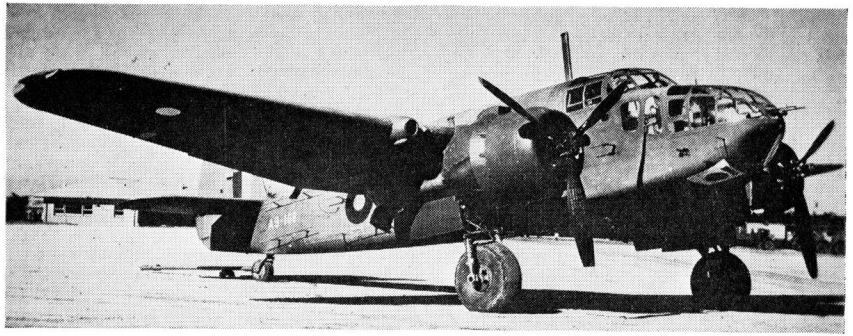
In view of the magnitude and complexity of the Australian Beaufort manufacturing programme, the time that passed between the placing of the initial production contracts in July 1939 and the flight of the first production aircraft in August 1941 cannot be considered over-long. The programme itself resulted from the recommendations made to the Commonwealth Government by a British Air Mission sent to Australia early in 1939 to investigate the possibility of manufacturing combat aircraft there for both the R.A.A.F. and the R.A.F. The scheme proposed called for the highest possible degree of decentralization, component parts and equipment being produced by several hundred specialist subcontractors and delivered to the railway workshops at Chullora (N.S.W.), Newport (Victoria) and Islington (South Australia), which were to make these up into complete sub-assemblies for delivery to two main assembly plants to be built at Mascot (Sydney) and Fishermen's Bend (Melbourne).

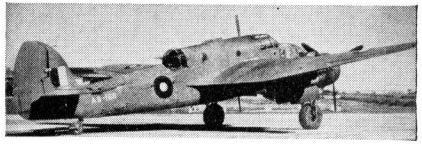
Some 80 Australian engineers and technicians selected as key personnel were sent to Britain for training, experienced personnel were loaned to Australia by the Bristol Company, and the Beaufort Division of the Department of Aircraft Production (D.A.P.), as the new organisation was named, received contracts on July 1, 1939 for 90 Beauforts for the R.A.A.F. and a similar quantity for the R.A.A.F. The scheme envisaged all drawings, jigs, tools and fixtures, together with a specimen airframe and 20 sets of airframe components being supplied from Britain, all power plants, gun turrets, instruments, forgings, extrusions and other specialized items being imported from the same source. Unfortunately, conditions resulting from the beginning of the war in Europe necessitated some drastic revision of the scheme, Australian engineers being forced to undertake more of the preliminary work, and a large number of jigs and tools having to be manufactured locally.

It was patently obvious that the greater urgency of home demands rendered the delivery of many items from Britain unlikely, and Australia was thrown upon her own resources for the manufacture of undercarriages, self-sealing fuel tanks, turrets, instruments and much other equipment, but the most pressing problem was that of the Beaufort's power plants. The Bristol Taurus was still at a relatively early stage of production development, its application to the Beaufort was proving troublesome, and it seemed unlikely that adequate numbers of this power plant would be available for the Australian Beaufort programme for some considerable

Beaufort A9-102, the twelfth production Mk.VII with S1C3-G engines. The glazed blister beneath the nose was deleted as its aft-firing Browning proved ineffective







(Above and right) The 18th production-Beaufort VA (A9-168), this model being identical to the earlier Mk.V apart from the enlarged vertical fin which was later applied to all R.A.A.F. Beauforts. Only 30 Beaufort VAs were produced, the last of these being delivered in November 1942

time to come, even assuming that an Axis blockade did not present serious transportation problems. Thus, in October 1939, the Australian government took the decision to adopt the Pratt & Whitney R-1830 Twin Wasp for its Beauforts, the Commonwealth Aircraft Corporation preparing plans to establish a plant at Lidcombe, N.S.W., specifically for the licence manufacture of the American engine, and de Havilland Aircraft Pty. Ltd. at Alexandria, N.S.W., negotiating for the licence for the Curtiss electric variable-pitch airscrew that it was to drive.

The pattern airframe (L4448), actually the eighth production Beaufort I from the parent company at Filton, was modified to take the Twin Wasp which, although some 120 lb. heavier than the Taurus, was only two inches larger in diameter, and flew successfully with its new power plants at Mascot for the first time on May 5, 1941. This conversion increased appreciably the burden of manufacturing the Beaufort in Australia. Nevertheless, the installation was "productionised" with remarkable rapidity, and within little more than three months from the initial flight of the Twin Wasp-engined Beaufort, the first production machine rolled off an Australian assembly line.

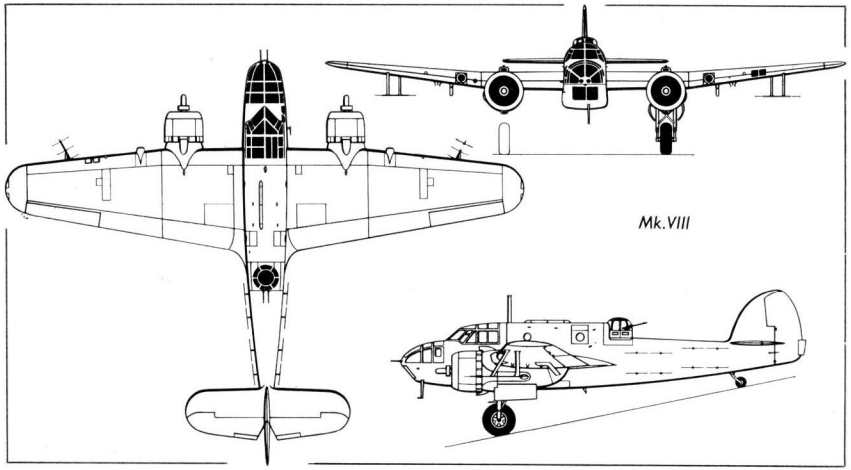
Produced largely from British-made parts, and designated **Beaufort V**, this aircraft was the first of 90 ordered for the R.A.F. from Australian production. Powered by R-1830 S3C4-G engines with two-speed blowers, offering 1,200 h.p for take-off and possessing military ratings of 1,200 h.p. at 4,900 ft. in low blower and 1,050 h.p. at 13,100 ft. in high blower, and driving Curtiss electric fully-feathering airscrews, the Beaufort V displayed improved level speed, climb rate and ceiling over the Taurus-engined Beaufort I. Defensive armament comprised a pair of 0.303-in. Vickers "K" guns in an hydraulically-operated Bristol B.IV Mark IE dorsal turret, a pair of similar weapons firing forward and mounted on gimbals in the extreme nose, and an aft-firing Browning in a blister attached to the emergency hatch in the floor of the fuselage nose, although this last weapon was not to prove very useful and was soon to be discarded. Internal stowage was provided for two 500-lb., four 250-lb., or eight 25-lb. bombs. Alternatively, a 21-in. torpedo could be slung in the bomb-bay semi-exposed. A crew of four was carried, the navigating station being combined with the bomb-aiming position in the extreme nose, the pilot's station being situated immediately above the front end of the bomb-bay with the radio-operator's station immediately behind, and the dorsal gunner being positioned further aft, at the extremity of the raised roof decking.

Ten Beaufort Vs had been completed by the beginning of December, and although not fully operational, seven of them were hurriedly flown to Singapore when Japan invaded Malaya in January 1942. However, the futility of despatching incompletely-equipped aircraft with semi-trained crews against a well-organised enemy was soon realised, and apart from one that remained in Malaya to perform reconnaissance missions, the Beauforts were returned to Australia. With the fall of Singapore it was appreciated that the immediate need of the R.A.A.F. was greater than that of the R.A.F., and the latter service relinquished its contract for Australian-built Beauforts in favour of the R.A.A.F., the aircraft then being allocated Australian serial numbers commencing A9-1 (this formerly being T9450).

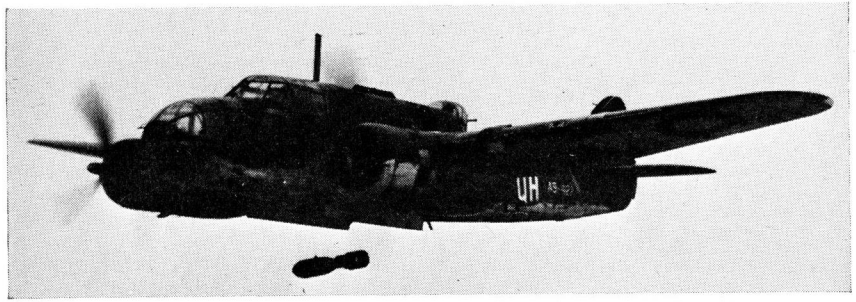
During the first months of 1942, production tempo rose steadily, but C.A.C.'s Lidcombe plant was unable to keep pace with airframe output, and a shortage of locally-manufactured S3C4-G Twin Wasps was soon being faced. This problem was overcome by importing from

the U.S.A. a quantity of S1C3-G Twin Wasps with single-speed blowers. These had the same take-off rating as the S3C4-G engines but provided maximum power of 1,200 h.p. at 3,700 ft., and the altitude performance of the Beaufort suffered accordingly. Fifty Beaufort Vs were completed (A9-1 to -50) with the S3C4-G engines before the imported S1C3-Gs were introduced on the assembly line, and with the latter power plant the bomber was redesignated **Beaufort VI**, but only 40 aircraft of this type (A9-51 to -90) had been completed when a shortage of Curtiss airscrews arose, this necessitating the introduction of Hamilton Standard bracket-type airscrews on the next 60 S1C3-G-powered aircraft (A9-91 to -150) which thus became **Beaufort VIIs**. Another change embodied by the Beaufort VII, apart from the airscrews, was a 15 per cent increase in vertical fin area introduced to improve stability and, in consequence, reduce pilot fatigue on long flights. The additional area was obtained by adding to the fin leading edge, and such was the success of the modification that all Australian Beauforts were subsequently modified in a similar fashion.

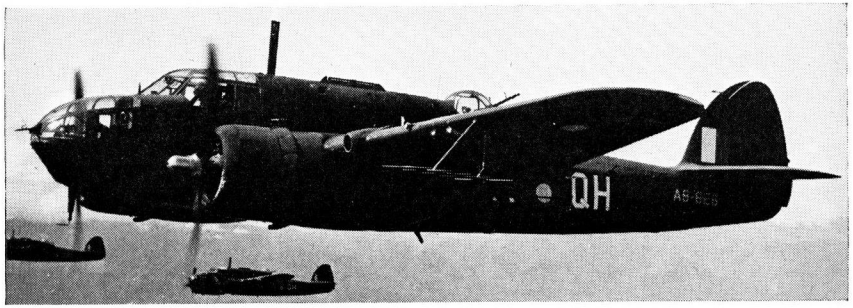
In the late summer of 1942, the power plant and airscrew supply problems had resolved themselves, the S3C4-G engine and Curtiss airscrew had been reinstated, and the initial contracts for 180 machines were completed with a batch of 30 **Beaufort VAs** (A9-151 to -180), these being identical to the earlier Mk.V apart from the enlarged fin. The last Beaufort



VA was delivered in November 1942, by which time further contracts had been placed with the Beaufort Division for what was to be the definitive production model, the **Beaufort VIII**. Standardizing on the S3C4-G engines with Curtiss airscrews, the Mk.VIII introduced the Bristol B.I. Mk.V dorsal turret with fixed cupola and twin Browning guns, British Loran A.S.V. radar with its Yagi aerial array, provision for either British or U.S. torpedoes or mines, and more minor changes. Beaufort VIII deliveries followed on the last of the



(Above) Beaufort Mk.VIII (A9-427) of No. 100 *Sqdn. during an attack on Japanese shipping, and (below) another Mk.VIII of No.* 100 *Sqdn. with Mk.VE turret and radar array*



D.A.P. BEAUFORT VIII SPECIFICATION

Type: *Four-seat Torpedo-bomber and Reconnaissance Aircraft.* **Power Plants:** *Two C.A.C.-built Pratt & Whitney R-*1830*-S3C4-G Twin Wasp* 14*-cylinder radial air-cooled engines each rated at* 1,200 *h.p. for take-off and* 1,050 *h.p. at* 13,100 *ft.* **Armament:** *(Defensive) Two gimbal-mounted* 0.303*-in. Browning Mk.II machine guns firing forward in the nose and one hydraulically-operated Bristol B.1 Mk.V dorsal turret with twin* 0.303*-in. Browning machine guns or Mk.VE dorsal turret with twin* 0.5*-in. Browning machine guns. (Offensive) Two* 500*-lb. or four* 250*-lb. bombs internally, or one* 21*-in. torpedo semi-internally, plus two* 250*-lb. bombs on underwing racks.* **Performance:** *Maximum speed,* 268 *m.p.h. at* 14,500 *ft.; range (at* 21,000 *lb.),* 1,060 *mls., (at* 22,500 *lb.),* 1,450 *mls.; initial climb rate (at* 21,000 *lb.),* 1,200 *ft./min.; service ceiling (at* 21,000 *lb.),* 25,000 *ft., (at* 22,500 *lb.),* 22,500 *ft.* **Weights:** *Empty,* 14,070 *lb.; normal loaded,* 21,000 *lb.; maximum loaded,* 22,500 *lb.* **Dimensions:** *Span,* 57 *ft.* 10 *in.; length,* 44 *ft.* 3 *in.; height,* 14 *ft.* 3 *in.; wing area,* 503 *sq. ft.*

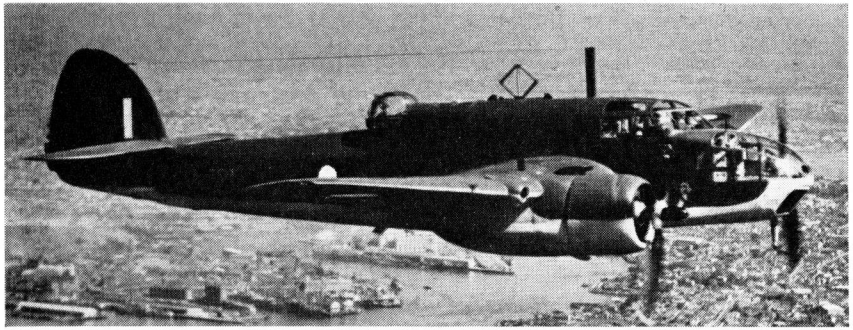
Beaufort VAs in November 1942, and by 1943 a production rate of 30 aircraft per month had been attained, a peak output of 37 machines being reached in September of that year.

A total of 520 Beaufort VIIIs (A9-181 to -700) had been built when production was finally phased out in August 1944, the last 140 of these being fitted with Australian-manufactured Mark VE dorsal turrets which, produced at Fairfield (Victoria), mounted twin 0.5-in. Brownings. During 1943, an early Beaufort VIII (A9-201), allocated to the Beaufort Division for communications duties, was modified on the assembly line, all operational equipment being removed, the step in the fuselage upper decking being faired off, seats for five passengers installed, and provision made for a cargo-carrying crate to be slung from the torpedo-carrier lugs in the bomb-bay. Initially flown on February 4, 1944, the aircraft was further modified by having its bomb-bay enlarged to accommodate a bigger cargo crate The enlarged bomb-bay did not meet with R.A.A.F. approval, and the aircraft reverted to its original transport configuration.

The Beaufort did not make an ideal transport, but such was the demand for aircraft capable of supply dropping in forward areas and transporting personnel at relatively high speeds that 46 Beaufort VIIIs awaiting major overhaul were converted to transport configuration in November 1944 at the Essendon (Victoria) Repair and Modification Centre. Allocated new serial numbers (A9-701 to -746), the transport conversions were redesignated **Beaufort IXs**. Carrying a payload of 4,000 lb., the Beaufort IX attained a maximum speed of 285 m.p.h., and saw extensive use during the final stages of the Pacific War with Nos. 1, 3, 4, 5, 6, 8 and 11 Communications Units.

OPERATIONAL CAREER

The first R.A.A.F. Beaufort squadron, No. 100, experienced its baptism of fire near Lae, New Guinea, in June 1942, in the early days of the Japanese occupation, sinking the supply vessel *Tenyo Maru.* Another Japanese vessel was sunk shortly afterwards in the vicinity of Milne Bay, and the squadron delivered a highly successful attack on Japanese naval vessels off Gasmata, New Britain, claiming one cruiser sunk and several destroyers damaged. On September 1, 1942, No. 100 Squadron was joined by No. 7 Squadron, also equipped with



The last Australian-built Beaufort Mk.VIII (A9-700) flying over Sydney Harbour in 1944, production having been phased out in August of that year

Beaufort Vs, to form No. 9 (Operational) Group at Milne Bay, New Guinea, and five days later they played a vital role in the first Allied victory of the war against the Japanese, routing a powerful invasion force in the vicinity of Normanby Island, off the tip of Papua.

The Beauforts continued to enjoy success throughout October, scattering a large Japanese naval force off the North-West Solomons, and sinking or seriously damaging three light cruisers and two medium-sized merchantmen anchored between Faisi Island and Buin, Bougainville, with torpedoes. By this time, the Beaufort was establishing an enviable reputation for itself. It had proved capable of standing up well to the rigours of primitive servicing arrangements under tropical conditions, although its excellent serviceability record was undoubtedly due in no small part to the field service representatives of the Beaufort Division attached to every squadron. It also proved able to defend itself against Japanese fighters. On one occasion, a lone Beaufort fought off six Zero-Sen fighters near New Britain, destroying one, damaging three, and driving off the remaining two. This was but one of many recorded incidents of Beauforts surviving the concentrated attacks of several Japanese fighters simultaneously.

As production tempo built up more squadrons converted to the Beaufort, and R.A.A.F. squadrons equipped with this type participated in the Bismarck Sea Battle of March 5, 1943, when Allied aircraft accounted for every vessel in a 22-ship convoy. Beauforts were soon attacking Japanese shipping with bombs and torpedoes in every part of the South-West Pacific area, but another vital task in which the Beaufort was engaged was that of patrolling Australia's 12,000 miles of coastline, and by October 1943, No. 7 Squadron in the N.E. Area, No. 32 Squadron in the Eastern Area,

and No. 14 Squadron in the Western Area were employing Beauforts in this role.

In addition to the previously-mentioned units, Nos. 1, 2, 6, 8, and 13 Squadrons all progressively converted to Beauforts, and No. 15 Squadron was formed on this type during the course of 1943. As the number of Beauforts grew they were increasingly employed in support of Australian ground forces and for tactical reconnaissance tasks, but among the most important operations of the Beaufort squadrons were the continuous attacks on Rabaul, the main Japanese base in the South Pacific, and the concentrations of Japanese shipping lying in Simpson Harbour, which continued until November 1944. In one six-month period, the Beaufort Wing engaged in attacking Rabaul and other enemy bases in New Britain flew 1.5 million operational miles, dropping nearly two million pounds of bombs, the loss ratio being at the remarkably low level of 0.7 per cent.

When the Pacific War ended, a very considerable proportion of the R.A.A.F.'s contribution had been made by the Australian-built Beaufort, which had performed a wider variety of functions than any other aircraft type employed in the Pacific. Its tasks ranged from torpedo attacks on enemy shipping, the bombing of enemy bases, strategic and tactical reconnaissance, and Army and Navy co-operation to coastal patrol and convoy escort, and its part in the defeat of the Japanese forces in the South-West Pacific was probably of greater importance than that of any other single aircraft type.

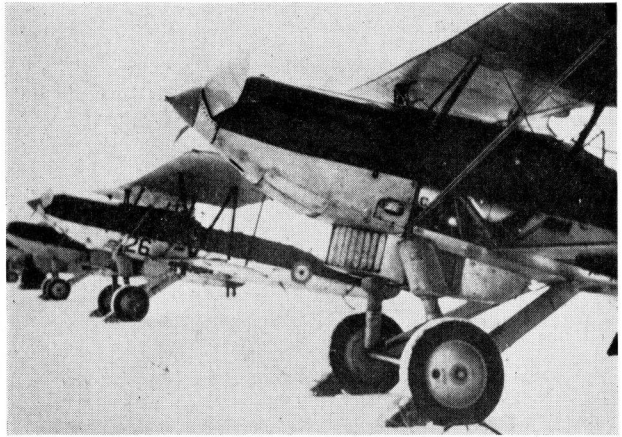
Crews of Nos. 8 and 100 Squadrons return from a Beaufort strike in New Guinea.

One of the 46 Beaufort Mk.IX transports (A9-736) converted from Beaufort Mk.VIIIs

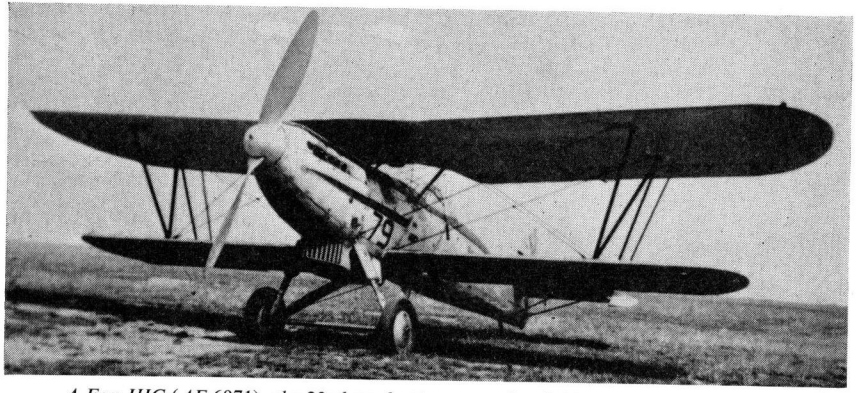
The story of the air war of 1939–45 is punctuated by individual and collective acts of bravery on the part of personnel of the air arms of all the combatants, but of the innumerable examples of outstanding courage few transcend those of pilots who, flying totally obsolete warplanes and knowing their chances of survival to be negligible, nevertheless faced an enemy possessing overwhelming technical and numerical superiority. Such pilots were those of the Fairey Foxes of Belgium's *Aéronautique Militaire*; pilots whose operational sorties were more of the nature of valiant if futile gestures than useful contributions to the struggle that was taking place on the ground beneath their antiquated mounts,

In its time, the Fox had been a trend setter, establishing standards that others had been quick to emulate, but on May 10, 1940, when German forces invaded Belgium, that time was long past, despite the fact that the last Fox had left the Belgian assembly line less than 12 months earlier. It was the misfortune of the *Aéronautique Militaire* that it possessed more first-line squadrons equipped with Foxes than squadrons equipped with all other types together.

The Foxes of the *Aéronautique Militaire* were the descendants of an aircraft which had established a new fashion in streamlining and had rudely shattered all official precepts on light bomber design at the time of its appearance, being capable of out-performing any contemporary single-seater fighter. Flown for the first time on January 3, 1925, the prototype was an extremely clean two-seat single-bay biplane day bomber of small dimensions powered by a 430 h.p. Curtiss D.12



Fox IIs of the 1er Régiment photographed during the winter of 1939–40 after the introduction of cockpit canopies

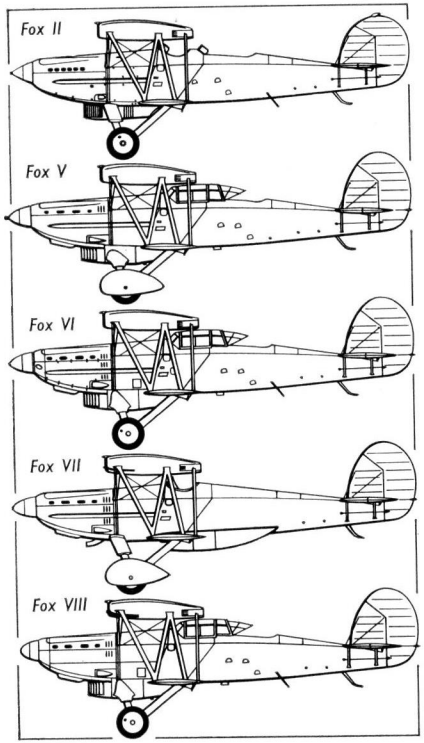


A Fox IIIC (AF 6071), the 23rd production example of this variant. The Fox IIIC introduced the semi-enclosed cockpit and served with the 1er and 3ème Régiments

engine. Financial limitations then appertaining restricted the R.A.F. order to 28 machines which, known as **Fox Is**, served with No. 12 Squadron from Augus 1926. Some Fox Is later had their Fairey Felix engines—the British version of the D.12 engine having received this appellation—supplanted by the Rolls-Royce Kestrel with which they were known as **Fox IAs.**

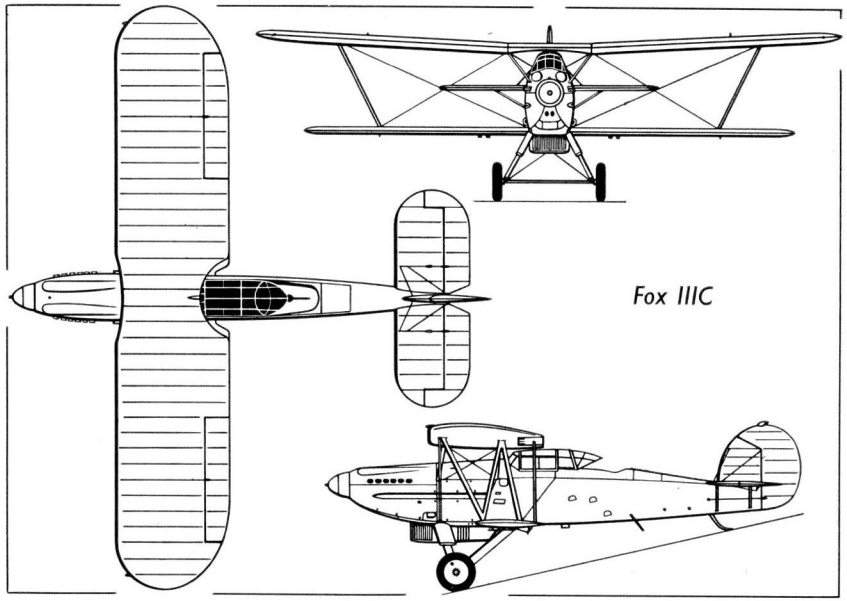
The issue of specification 12/26 resulted in a complete redesign of the Fox, a new prototype emerging in 1929 as the **Fox IIM** powered by an unsupercharged Rolls-Royce F.XIB (Kestrel IB) engine. Whereas the Fox I had been primarily of wooden construction, only the central portion of the fuselage being of metal, the Fox IIM was of metal construction with a steel-tube fuselage and wing spars of high-tensile steel strip, hence the "M" suffix letter. The Fox IIM competed directly with the Avro Antelope and the Hawker Hart in Martlesham Heath evaluation trials, the last-mentioned type being selected for the R.A.F. primarily on the score of its remarkable ease of maintenance. Here the story of the Fox could well have terminated had not the Belgian Air Staff formulated a requirement at this time for a multi-purpose two-seater which was to supplant the antiquated Breguet XIX in service with the *Aéronautique Militaire*. In 1930, the Fairey company had enjoyed some success in Belgium, having obtained an order for the Firefly single-seat fighter, and as the Belgian government had stipulated that Belgian labour had to be employed for the assembly of a considerable proportion of the aircraft, work had been initiated on a factory at Gosselies in Belgium which was to be run by a separate Belgian company, the Société Anonyme Belge

"Avions Fairey" S.G.B.A. A second prototype of the Fox IIM was flown to Belgium for demonstration purposes in 1931, and the Fairey company was again successful in obtaining a contract, a batch of 12 machines being ordered, it being understood that any further production would be handled at Gosselies.



Fox II: The prototypes of the Fox IIM with the unsupercharged Kestrel IB attained 152 m.p.h. at 10,000 ft. and145 m.p.h. at 15,000 ft., but the Belgian contract stipulated the installation of the supercharged Kestrel IIS similar to that being installed in the Firefly, and this boosted maximum speed to 189 m.p.h. at 16,400 ft. Provision had been made in the original design for a prone bombing position in the rear cockpit and a bomb load of either two 220-lb. or four 110-lb. bombs, but as the *Aéronautique Militaire* requirement was for a reconnaissance and observation aircraft, armament was confined to a single 7.62-mm. Vickers gun with 250 rounds firing through a trough in the portside of the forward fuselage, and a Lewis gun on a Fairey mounting in the observer's cockpit.

On January 10, 1932, Belgian pilots collected the initial three Fox IIs and ferried them to the *Etablissements d'Aéronautique* at Evère, and shortly afterwards they were passed to the *9ème Escadrille* of the *5ème Groupe de Reconnaissance* which received the remaining nine aircraft on the initial contract in the weeks that followed. The capabilities of the Fox II were quickly demonstrated by the *Aéronautique Militaire* when, on July 8, 1932, one of the newly acquired aircraft won the two-seater contest in the International Circuit of the Alps, covering the 229 miles in 85.75 min. at an average speed of 161 m.p.h., and contracts were placed with the Gosselies plant for a further 28 aircraft, including two dual-control **Fox IIS** models, the first Belgian-built Fox II leaving the line on April 21, 1933, and the 28th being completed during the following November. These were delivered, like the initial



batch of 12, to the squadrons of the *1er Régiment d'Aéronautique*.

Fox III: On December 28, 1933, the first example of the Fox III was rolled out at Gosselies, this differing from its predecessor primarily in having an additional fixed forward-firing 7.62-mm. FN-Browning machine gun in the fuselage, all Belgian-built machines having standardised on this weapon. Almost simultaneously, the parent company in Britain had produced the dual-control **Fox Trainer** with a 360 h.p. Armstrong Siddeley Serval air-cooled radial engine. At the request of the Belgian Air Staff, this machine was sent to Belgium for evaluation, and subsequently re-engined at Gosselies with the moderately supercharged Kestrel IIMS, emerging on April 4, 1934 as the **Fox IIIS.** Five similar machines were built at Gosselies before, in mid-1934, production

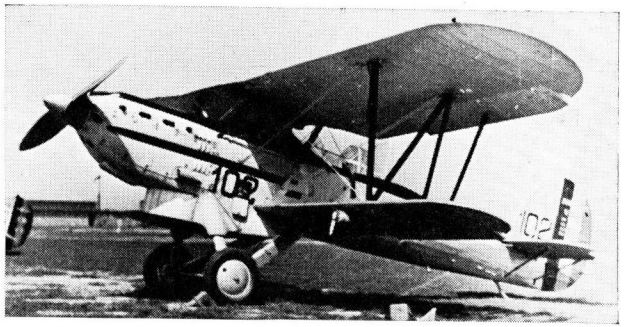
began of the **Fox IIIC**, the "C" suffix letter indicating *Combat*, this model being intended to perform a secondary light bombing role, although its primary tasks remained reconnaissance and army co-operation.

The Fox IIIC was essentially similar to the Fox III, retaining the Kestrel IIS engine and armament of two forward-firing and one swivelling FN-Browning, but provision was made for the attachment of bomb shackles beneath the lower mainplanes, and hinged transparent canopies were fitted over the cockpits. The canopy enclosing the pilot was hinged to starboard, and that covering the observer's position was arranged so that it could be raised vertically to enable the observer to stand upright to operate his gun free of slipstream. Between September 1939 and May 1940, similar canopies were to be fitted to the British-built Fox IIMs and the Gosselies-built Foxes II and III.

Production of the Fox IIIC was not completed until May 1937 when the last of a final batch of 12 machines of this type was delivered, bringing total production of the Fox IIIC to 49 machines plus one dual-control **Fox IIICS** for the *Ecole de Perfectionnement*. The last 12 machines differed from earlier Fox IIICs in having the fully supercharged Kestrel V rated at 600 h.p. at 11,000 ft. and having a maximum rating of 640 h.p. at 14,000 ft.

Fox VI: Earlier, on December 31, 1934, yet another Fox variant had been completed at Gosselies. This was basically a Belgian-built Fox II airframe with an Hispano-Suiza 12Ybrs 12-cylinder liquid-cooled engine rated at 775 h.p. at sea level and 860 h.p. at 13,120 ft., and was designated **Fox IV**. Shortly after the completion of initial flight trials, the Fox IV was loaned to the parent company in Britain and, fitted with similar cockpit canopies to those adopted for the Fox IIIC and streamlined spats enclosing the mainwheels, the aircraft temporarily became the **Fox V**, adding the role of long-range fighter to its repertoire, a task that it was intended to perform as a single-seater. After protracted testing at Hayes, the aircraft was returned to Gosselies where the wheel spats were removed and an Hispano-Suiza 12Ydrs engine installed in place of the HS 12Ybrs, this providing 830 h.p. for take-off and 860 h.p. at 10,660 ft. Once again redesignated, this time as the **Fox VIR** (the "R" suffix letter indicating *Reconnaissance*), the aircraft displayed a marked performance improvement over the Kestrel-engined Fox, attaining a maximum speed of 227 m.p.h. at 13,120 ft., taking-off within 60 yards and climbing to 19,685 ft. in less than 8.5 minutes. The new power plant increased overall length from 29 ft. 9¾ in. to 30 ft. 9 in., and 87 octane fuel replaced the 77 octane fuel used by the Kestrel, but fuel capacity remained unchanged at 84 Imp. gal. distributed between the main 44 Imp gal. tank and two 20 Imp. gal. tanks. Oil tank capacity was increased from 7 to 12 Imp. gal.

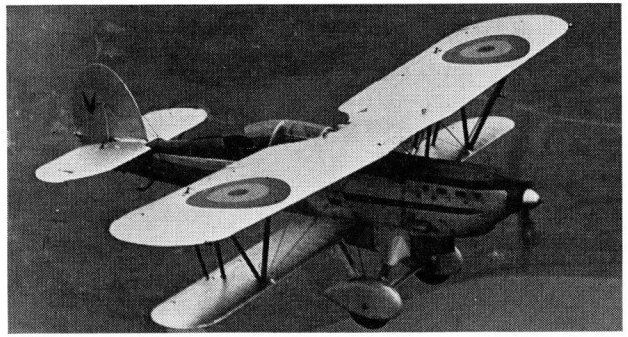
The Fox VIR was ordered into production in 1934 alongside the Fox IIIC after demonstrations to the Belgian Air Staff in August of that year, and a production rate of three aircraft per week was attained early in 1935 against a contract for 24 Fox VIR reconnaissance aircraft which were subsequently delivered to the *7ème Escadrille* of the IV*ème Groupe*. Almost all the Foxes produced to this time had been delivered to the various *escadrilles* of the 1*er Régiment* and, from late 1935, to the newly-formed 3*ème Régiment* for observation and reconnaissance tasks, but with the formation of the *Défense Aérienne du Territoire* (DAT) at the end of 1935, accompanied by the decision to increase the number of fighter squadrons, the Fox was to be manufactured for a new role, that of two-seat fighter.



Fox VIR (AF 6084), 24 examples of which were delivered to Belgium's Aéronautique Militaire, serving with the 7ème Escadrille of the 1er Régiment and the 5ème Escadrille of the 2ème Régiment

The Gosselies factory had developed a single-seat fighter version of the Fox VIR which, unofficially dubbed *Kangourou* as a result of the transfer of the large ventral radiator bath further aft, was officially known as the **Fox VII**. Two additional forward-firing FN-Browning machine guns were installed in the upper wing, and the Fox VII attained a maximum speed of 233 m.p.h. at 14,100 ft., climbing to 16,400 ft. in seven minutes, but only two examples of this model were produced, one of these quickly reverting to the standard two-seat configuration and the other being retained as a single-seater and being flown by Major Willy Coppens de Houthulst, Belgium's leading World War I fighter ace and commander of the II*ème Groupe de Chasse*. Despite the superior performance offered by the Fox VII, the Belgian Air Staff ordered a simpler adaptation of the Fox VIR for two new *escadrilles*, the 5*ème* and 6*ème*, that were being formed at the III*ème Groupe de Chasse*. Designated **Fox VIC**, this aircraft, despite its role as a two-seat fighter, differed from the Fox VIR solely in the type of radio equipment installed, and 52 aircraft of this type were subsequently delivered by the Gosselies plant, the first being completed on September 21, 1935.

Fox VIII: By August 1938, tension was steadily increasing in Europe yet the Belgian Ministry of Defence had still to select a replacement for the Fox with the reconnaissance and observation elements of the *Aéronautique Militaire*, let alone an even more urgently needed replacement in the fighter units, and earlier yet another order had been placed for the Fox with the Gosselies plant, this calling for 15 Fox VIIIs. This new variant embodied minor refinements which had little effect on the now totally obsolete warplane's performance or effectiveness. The Hispano-Suiza 12Ydrs engine was retained but the two-bladed wooden airscrew was replaced by a three-bladed Ratier or Fairey-Reed metal airscrew, and the guns were removed from the fuselage sides and supplanted by provision for a quartette of 7·62-mm. FN-Browning machine guns in the upper wing, although, in the event, only two guns were fitted. The 15th and last Fox



(*Above*) *The Fox VM* (*AF* 6031), *previously a Fox II and then Fox IVM, and subsequently the first Fox VIR.* (*Below*) *One of the six Fox IIIS trainers*

VIII came off the production line on May 25, 1939, bringing production of the Fox in Belgium to 190 aircraft, two Fox VIRs having been supplied to Switzerland. The Fox VIIIs were shared between the 5*ème* and 6*ème Escadrilles* of the *IIIème Groupe* to supplement the Fox VICs already serving with these units.

OPERATIONAL CAREER

When German forces invaded Belgium on May 10, 1940, the strength of the 1*er Régiment* whose task was army co-operation included the 1*ère Escadrille* based at Deurne with 10 Fox IIs and IIIs, the 3*ème Escadrille* with 12 Fox IIs, IIIs, and IIICs at Gossoncourt, and the 5*ème* and 7*ème Escadrilles* at the same base, the former with 10 Fox IIs, IIIs and IIICs, and the latter with eight Fox VIRs. The 1*ère Escadrille* subsequently flew 31 operational sorties, the 3*ème* flew 11 and the 5*ème* and 7*ème* each flew three, the 1*er Régiment* losing a total of 10 aircraft during its 48 missions, but no fewer than 18 of its Foxes had been destroyed on the ground in surprise attacks by the *Luftwaffe*. By May 18th, the Fox-equipped squadrons of the 1*er Régiment* were virtually the only elements of the *Aéronautique Militaire* remaining on Belgium soil, other units having been withdrawn to France, mostly without aircraft.

The 2*ème Régiment* included two Fox-equipped fighter squadrons on its strength, these being the 5*ème Escadrille* with 15 Fox VICs and VIRs, and the 6*ème Escadrille* with 14 Fox VICs and one single-seat Fox VII. The attack caught the 5*ème* deployed on manoeuvres at Shaffen, and during the first morning of the invasion, nine of the Fox VICs flown as single-seaters intercepted a formation of Messerschmitt Bf 109s, losing three of their number. Only one further sortie was flown by the unit before its surviving aircraft were destroyed on the ground by strafing attacks. The 6*ème Escadrille* which was at Le Zoute on armament practice was even less fortunate than the 5*ème*, losing virtually all its aircraft on the ground before it could perform any operational sorties.

The 3*ème Régiment*, whose task was tactical reconnaissance, comprised the 1*ère* and 3*ème Escadrilles* based at Evère, each with nine Fox IIIs and IIICs, and the 7*ème Escadrille* at Shaffen with nine Fox VIIIs. The 3*ème* and the 7*ème* undertook 11 and six operational missions respectively, losing seven of their aircraft during the course of these, all the remaining aircraft of the 3*ème Régiment* being destroyed by the *Luftwaffe* on the ground. The Foxes of the *Aéronautique Militaire* thus flew 65 operational sorties before Belgian resistance finally terminated, forming a major proportion of this air arm's total effort.

Fairey Fox VIR Specification

Type: *Two-seat Reconnaissance, Observation and Light Bombing Aircraft.* **Power Plant:** *One Hispano-Suiza* 12*Ydrs* 12-*cylinder liquid-cooled Vee engine rated at* 830 *h.p. for take-off and* 860 *h.p. at* 10,660 *ft.* **Armament:** *Two fixed forward-firing* 7.62-*mm. FN-Browning machine guns with* 250 *r.p.g. and* (*optional*) *one or two* 7.62-*mm. FN-Browning machine guns on flexible mounting in rear cockpit, plus* (*some aircraft*) *four* 22-*lb. or* 55-*lb. bombs on underwing racks.* **Performance:** *Maximum speed,* 224 *m.p.h. at* 13,120 *ft.,* 207 *m.p.h. at* 4,920 *ft.; time to* 16,400 *ft.,* 6.5. *min, to* 19,685 *ft.,* 8.35 *min.; service ceiling,* 32,800 *ft.* **Weights:** *Empty,* 2,920 *lb.; loaded,* 5,170 *lb.* **Dimensions:** *Span,* 37 *ft.* 11 *in.; length,* 30 *ft.* 9 *in.; height,* 11 *ft.* 6½ *in.; wing area,* 362.5 *sq. ft.*

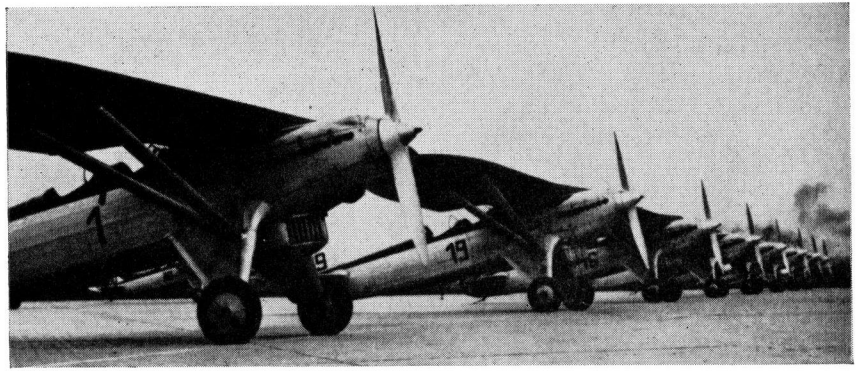
A Fox VIII (*AF* 6145) *of the 7ème Escadrille of the 3ème Régiment at Shaffen. The Fox VIII had twin Brownings in upper wing and Ratier or Fairey-Reed airscrew*

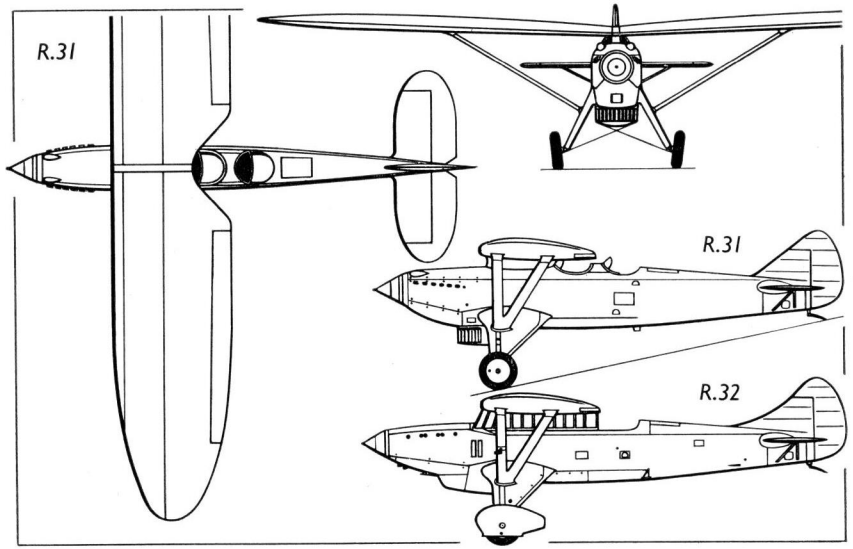
RENARD R-31 BELGIUM

From the earliest years of military aviation the army has demanded the support of aircraft capable of performing such mundane tasks as short-range frontline reconnaissance, artillery spotting, supply-dropping, liaison and communications, and the collecting of field despatches on message hooks. These functions had invariably been fulfilled by adaptations of obsolescent aircraft, but during the early 'thirties, a trend developed towards the design of more specialized aircraft for such roles, a trend which was to reach its ultimate in the Westland Lysander. A prerequisite in the design of such aircraft was a high-mounted wing in order to provide an adequately unobstructed downward view for the crew members, and reasonable short-field characteristics were desirable, but high performance and long endurance were considered unnecessary. A typical product of such thinking was the R-31 which, destined to be the sole aircraft of Belgian design and construction to see operational service during the 18 days in which Belgian forces resisted the German invasion of their country, was designed by Alfred Renard of Constructions Aéronautiques G. Renard of Evère, near Brussels.

Designed to meet a requirement for a tactical reconnaissance and army co-operation aircraft for Belgium's *Aéronautique Militaire*, and flown for the first time at Evère on October 16, 1932, the **R-31** was a parasol monoplane of metal construction with a Rolls-Royce Kestrel II.S 12-cylinder liquid-cooled engine. The wing was a conventional two-spar arrangement with diagonal cross bracing in the form of a Warren

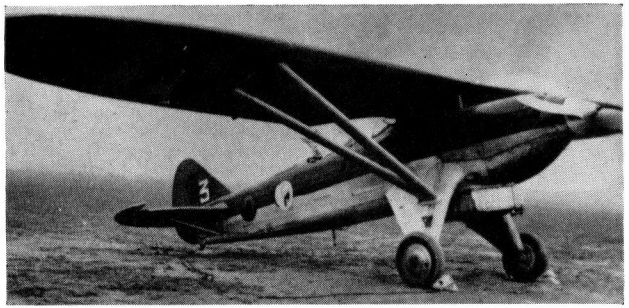
Renard R-31s of the 1er Régiment at Bierset in the spring of 1937. It will be noted that the first aircraft in the line lacks the gun bulge on the starboard fuselage side





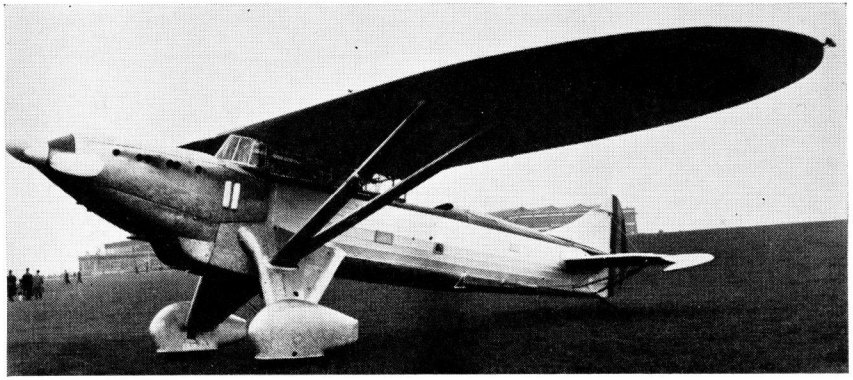
truss, built in two sections, joined at the centre-line, and carried above the fuselage by faired vertical struts from the fuselage mainframes, and a single inclined Vee-strut on each side from the undercarriage fairing to mid span. The leading edges were covered by duralumin sheet and the remainder by fabric. The rectangular-section fuselage, which was faired to an oval, was covered forward by detachable light metal panels which also covered the upper and lower decking aft, the remainder being fabric covered. Apart from automatic slots along the inner halves of the wing leading edges, the R-31 had no high-lift devices, although the long-span ailerons also served as flaps.

In March 1934, an order for 28 machines was placed on behalf of the *Aéronautique Militaire*, and of these six were to be produced by the parent company and the remaining 22 by the Société Anonyme Belge de Constructions Aéronautiques (SABCA). The production R-31 differed little from the prototype, apart from the deletion of the Scarff ring gun mounting in the observer's cockpit, and the first aircraft were completed late in 1934, the second production aircraft being fitted



(Left) A Renard R-31 of the 9ème Escadrille based at Bierset, and (at foot of page) the 10th production airframe during trials as the Hispano-Suiza 12Y-powered R-32. This aircraft subsequently reverted to standard R-31 configuration

with a 580 h.p. Lorraine Petrel 12-cylinder liquid-cooled engine for comparison purposes, although this was later replaced by the standard Kestrel II.S. During the course of 1935, the tenth production R-31 was modified by the fitting of a long "glasshouse" from the wing leading edge to the observer's cockpit, an extended vertical fin, and a Gnôme-Rhône

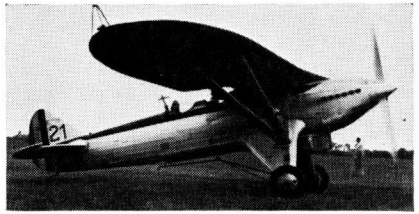


14Krsd 14-cylinder radial air-cooled engine offering 1,065 h.p. for take-off and 815 h.p. at 7,150 ft. With these modifications the aircraft was redesignated **R-32**. The Gnôme-Rhône radial was then supplanted by an Hispano-Suiza 12Ydrs 12-cylinder liquid-cooled engine of 830 h.p. for take-off and 860 h.p. at 10,660 ft., but the R-32 did not display sufficient improvement over the R-31 to warrant a production order, and soon reverted to standard configuration. In August 1935, a further six R-31s were ordered from Renard, and the first deliveries to the *Aéronautique Militaire* were made in the following December.

SERVICE CAREER

The R-31 did not prove a popular aircraft with *Aéronautique Militaire* pilots. It was by no means an easy aircraft for a novice to fly. It was unforgiving and prone to developing a flat spin, and the pilots notes forbade all aerobatics. Provision was made for mounting one 7.62-mm. Vickers machine gun in a blister fairing on each side of the fuselage, but most production aircraft mounted only one gun on the starboard fuselage side, plus a Lewis gun on a flexible mounting in the observer's cockpit.

The R-31s were issued to the 9e *Escadrille* of the Ve *Groupe* of the 1ere *Régiment* and the 11e *Escadrille* of the VIe *Groupe* of the 1ere *Régiment*, both of which units were based at Bierset, just west of Liège. All the R-31s escaped destruction on the ground by the *Luftwaffe* during the first attack on Bierset on May 10, 1940, but several aircraft that were undergoing overhaul or repair and could not be made airworthy quickly had to be left behind when the base was evacuated. During the following 17 days, the R-31s of the 9e and 11e *Escadrilles* flew 41 operational reconnaissance missions in support of the Allied forces, but the number of airworthy aircraft diminished



R-31 (No. 21) equipped with message pick-up hook beneath fuselage

rapidly as the units retreated from base to base, and the final mission, which was also destined to be the last mission flown by an aircraft of Belgium's *Aéronautique Militiare* during the German invasion of Belgium was flown in the late afternoon of May 27th from Steene, in the vicinity of Ostend.

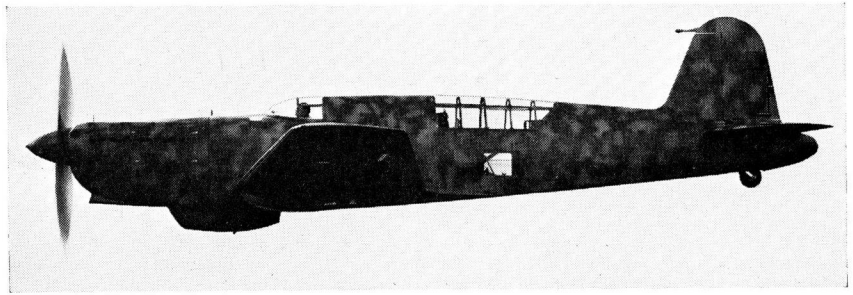
Renard R-31 Specification

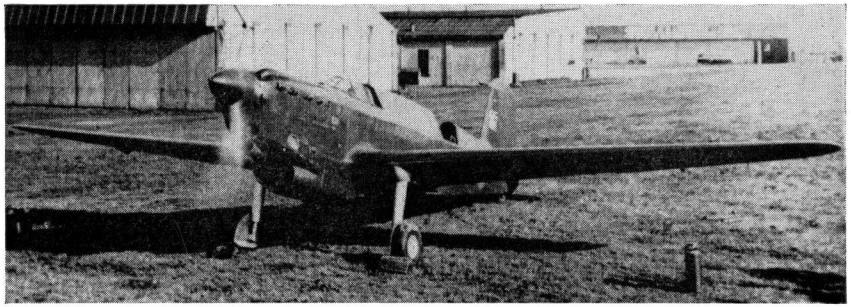
Type: *Two-seat Tactial Reconnaissance and Army Co-operation Aircraft.* **Power Plant:** *One Rolls-Royce Kestrel II.S 12-cylinder liquid-cooled Vee engine rated at 525 h.p. for take-off and 480 h.p. at 11,800 ft.* **Armament:** *One or (optional) two 7.62-mm. Vickers machine guns fixed to fire forward from fuselage side(s), and one 7.62-mm. Vickers "K" gun in observer's cockpit.* **Performance:** *Maximum speed, 155 m.p.h. at sea level, 172 m.p.h. at 6,560 ft., 183 m.p.h. at 13,120 ft.; normal cruising speed, 148 m.p.h. at 6,560 ft.; climb to 6,560 ft., 5.5 min., to 16,400 ft. 11.7 min.; ceiling, 28,700 ft.* **Weights:** *Empty, 2,926 lb.; loaded, 4,686 lb.* **Dimensions:** *Span, 47 ft. 2¾ in.; length, 30 ft. 2 in.; wing area, 344.445 sq. ft.*

In October 1937, the Société Anonyme Belge de Constructions Aéronautiques (SABCA) of Brussels-Haren reached a collaboration agreement with Aeroplani Caproni S.A. under which the Belgian company was to act as sales agent for various Caproni-designed military aircraft in certain countries, these aircraft being allocated SABCA type numbers (e.g., the Ca 135 being redesignated S.45bis, the Ca 310 the S.46, and the Ca 312 the S.48). The agreement also included technical collaboration in the design and development of a tandem two-seat fighter-bomber, attack and reconnaissance aircraft primarily to meet a specification prepared by the *Ministère de la Defense Nationale Belge* for a successor for the Fox biplane in service with Belgium's *Aéronautique Militaire*.

Under the agreement Caproni was to design and manufacture a prototype of an aircraft derived from the A.P.1 for which SABCA was to furnish an Hispano-Suiza 12Y engine, engine bearers, airscrew and armament, installing these items at the Brussels-Haren plant, and subsequently performing all development and flight testing. The airframe of the aircraft, which received the Caproni designation **Ca 335 Maestrale** (Mistral) was built at the Ponte San Pietro plant where a mock-up of the engine furnished by SABCA was installed. The prototype was transported to SABCA's plant on June 19, 1939, and in the following month was exhibited at the *Salon de l'Aéronautique* in Brussels as the SABCA **S.47**. After the *Salon* the prototype was fitted with its Hispano-Suiza 12Ycrs engine, three-blade constant-speed airscrew and twin wing-mounted 7.62-mm. FN-Browning machine guns which supplemented the engine-mounted 20-mm. Hispano cannon, and the flight test programme was initiated by SABCA's chief test pilot, P. Burniat, a certificate of airworthiness being issued on September 19, 1939.

The SABCA S.47 in the form in which it was initially flown in the summer of 1939. *The S.47 was intended as a successor to the Fox in Belgian service*



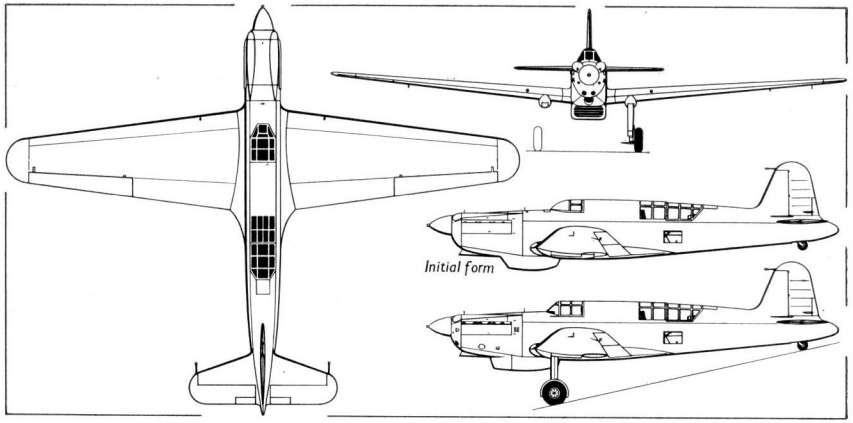


The SABCA S.47 photographed at Brussels-Evere in November 1939, *after redesign of the ventral radiator bath and modifications to the pilot's windscreen*

The S.47 was of mixed construction with wooden wings and tail surfaces and a welded chrome-molybdenum steel tube fuselage structure. The wings comprised a single main spar with integral D-type leading edge and former ribs, plywood skinning being applied aft of the main spar, the whole being covered by doped fabric. Split flaps were carried between the ailerons and fuselage. The fuselage had light metal skinning, and all tail surfaces were covered by plywood and then doped fabric. The main undercarriage members, which were actuated hydraulically, retracted aft, the main-wheels turning to lay flat in wing wells, and full dual controls were provided for the two crew members, the gunner in the rear cockpit being provided with a single FN-Browning gun.

After initial trials, as a result of which some redesign of the ventral radiator bath and modifications to the pilot's windscreen were undertaken, SABCA purchased a manufacturing licence for the S.47 on November 30, 1939, and subsequently demonstrated the aircraft at Brussels-Evère for the *Ministère de la Defense*, and for Dutch, Danish, Swedish, Norwegian, Swiss, Portuguese, and Venezuelan delegations. The representatives of Belgium's *Aéronautique Militaire* were favourably impressed by the performance and characteristics of the S.47, and SABCA formulated plans for the quantity production of the aircraft, but at that time the Brussels-Haren plant was engaged primarily in fulfilling contracts for 32 Breguet 694s for the *Aéronautique Militaire* and nine Breguet 693s and 10 Koolhoven F.K.58As for France's *Armée de l'Air*. On March 14, 1940, the prototype S.47 was flown to Bricy-Orléans for demonstration to the *Armée de l'Air*. Unfortunately, the S.47 was lightly damaged in a collision on the ground while at Bricy, and it was not possible to evacuate the aircraft before the arrival of German forces in June. The aircraft was still at Bricy in mid-1943, and efforts on the part of Caproni to recover the aircraft were unsuccessful.

No production order for the S.47 had been



placed by the *Ministère de la Defense Nationale Belge* by the time German forces invaded Belgium on May 10, 1940, and the subsequent occupation of the country necessitated the abandoning of SABCA's plans to manufacture the aircraft in series.

SABCA S.47 SPECIFICATION

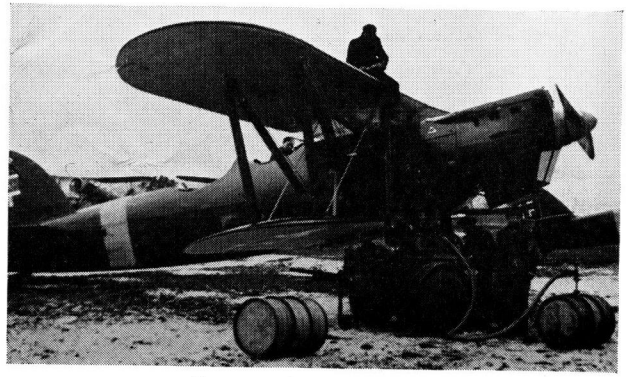
Type: *Tandem Two-seat Light Bomber, Attack and Reconnaissance Aircraft.* **Power Plant:** *One Hispano-Suiza 12 Ycrs. twelve-cylinder inverted Vee liquid-cooled engine rated at 860 h.p. for take-off and 835 h.p. at 13,780 ft.* **Armament:** *One 20-mm. Hispano cannon with 100 rounds and three 7.62-mm. FN-Browning machine guns with 300 r.p.g. plus two 110-lb. bombs beneath the fuselage and ten 22-lb. bombs beneath the wings.* **Performance:** *(At 6,559 lb.) Maximum speed, 258 m.p.h. at sea level, 311 m.p.h. at 13,780 ft.; endurance, 2 hr.; time to 6,560 ft., 3 min. 30 sec., to 13,120 ft., 7 min. 20 sec., to 19,685 ft., 12 min. 20 sec.; service ceiling, 31,170 ft.; (reconnaissance mission at 7,143 lb.) range, 979 mls. at 217 m.p.h. at 13,780 ft.; endurance, 4 hr. 30 min.; climb to 6,560 ft., 4 min. 20 sec., to 13,120 ft., 8 min. 30 sec.; to 19,685 ft., 15 min. 20 sec.; service ceiling, 31,168 ft.* **Weights:** *Empty, 4,960 lb.; loaded (clean), 6,559 lb., (reconnaissance mission), 7,143 lb.; maximum, 7,385 lb.* **Dimensions:** *Span, 43 ft. 3¾ in.; length, 34 ft. 9¾ in.; height, 10 ft. 6 in.; wing area, 256.18 sq. ft.*

AERO A-100–101 (CZECHOSLOVAKIA) BOHEMIA-MORAVIA

Although within 12 months of the commencement of World War II the biplane had largely disappeared from the first-line inventories of the principal combatants, such aircraft lingered with the air arms of the smaller participants for considerably longer and, in some cases, throughout the period of hostilities. The light tactical reconnaissance and bombing biplanes manufactured during the mid 'thirties in Czechoslovakia by the Aero Tovarna Letadel Dr. Kabes at Prague-Vysocany provide a case in point.

When, on March 15, 1939, the *Wehrmacht* occupied Bohemia and Moravia, dissolving the Czechoslovak Republic, a number of Aero A-100 and A-101 two-seat tactical reconnaissance biplanes and their light bomber counterpart, the Ab-101, were serving with the Czechoslovak Army Air Force. Seized by the German forces, these were, for the most part, handed over to the newly created independent republic of Slovakia when an indigenous air arm was established under *Luftwaffe* patronage, seeing brief action in September 1939 when the Slovak Air Force rendered token assistance to the German forces in the assault on Poland, and continuing in service, although mostly in secondary roles, for several years.

The **Aero A-100** made its début in 1933 in answer to a specification issued by the Czechoslovak Ministry of National Defence which called for a two-seat light reconnaissance-bomber. Powered by an Avia Vr-36 (licence-built Hispano-Suiza 12Nbr) 12-cylinder liquid-cooled engine with a maximum rating of 725 h.p. and a nominal output of 650 h.p., the Aero A-100 was an unequal-span single-bay biplane with a welded steel-tube fuselage and wooden wings, and armament comprised a pair of fixed forward-firing 7.92-mm. Ceska-Zbrojovka (Vickers) machine guns, a pair of Lewis guns for the observer, and a 1,323-lb. bomb load carried partly vertically in a forward fuselage bay and partly horizontally on external racks.

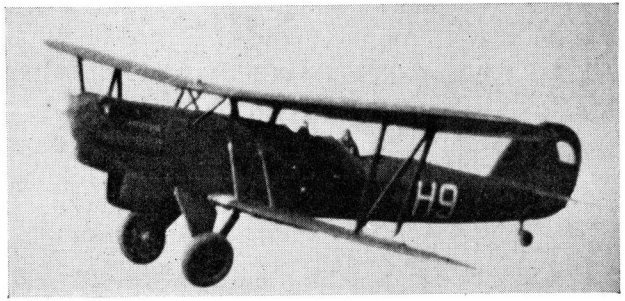


An Aero A-100 serving with the Slovak Air Force. The A-100 remained in the Slovak first-line inventory until 1942

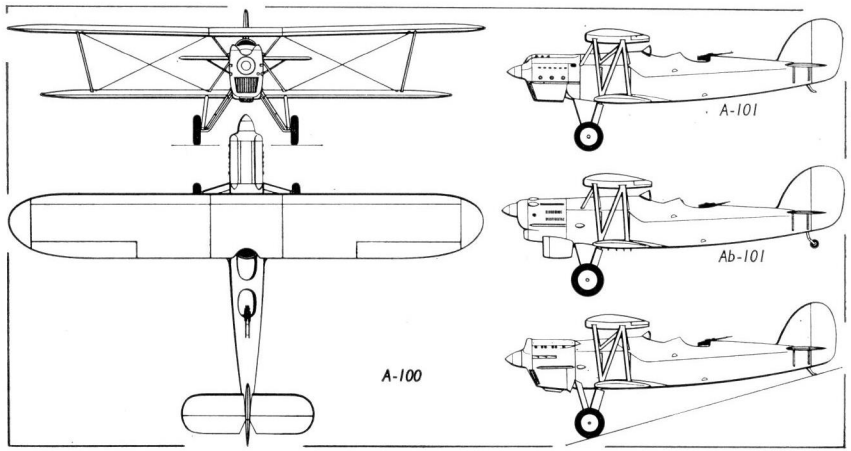
A further develpoment of the basic design, the **A-101**, appeared in 1934, this featuring substantial increases in wing span and area, a lengthened fuselage, an enlarged rudder and a ČKD-Praga-built Isotta-Fraschini Asso-1000 18-cylinder liquid-cooled W-engine with a normal rating of 800 h.p. and a maximum output of 1,000 h.p. This heavy engine, which weighed 615 lb. more than the Avia Vr-36, was soon discovered to be unsuited for its air frame, the A-101 offering an extremely disappointing performance, and thus, when late in 1936 the Spanish Republican government offered to purchase the aircraft of this type from the Czechoslovak government, the opportunity to relinquish the A-101 was seized with alacrity. More than 50 A-101s were sent to Spain but not all of these reached Republican hands as, on April 15, 1937, the Panamanian freighter *Hordena* en route from Gdynia to Santander with 22 Aero A-101s aboard was intercepted and captured by the Nationalist cruiser *Almirante Cervera*. The A-101s were assembled and issued to a newly-formed unit, *Grupo* 17, which first used them as bombers in the Brunete area in August 1937. Dubbed *Ocas* by the Nationalists, the Aero A-101 was by no means popular with its crews, and after some use for army co-operation and tactical reconnaissance, it was withdrawn from operational service and relegated to the *Escuela de Observadores* at Mālaga as a trainer. The thirty A-101s that did reach the Republicans were employed quite extensively, and 16 of these were captured at Barajas when the Civil War ended.

In the meantime, the Asso-1000 engine had been replaced in the A-101 by the ČKD-Praga-built Hispano-Suiza 12Ydrs with a normal output of 775 h.p. at sea level and a maximum output of 860 h.p. at 13,120 ft., this development appearing in 1935 and being designated **Ab-101**. Although overall wing span remained unchanged at 55 ft. 9¼ in., overall length was increased from 39 ft. 8 in. to 41 ft. 0 in. as a result of the longer engine bearers demanded by the lighter HS 12Ydrs engine in order to maintain the c.g. position. The Ab-101 offered improved climb rate, service ceiling and range by comparison with the A-101, and increased useful payload, and production for the Czechoslovak Army Air Force continued until 1937, total production of A-100, A-101 and Ab-101 aircraft being 137 machines.

In March 1939, the Ab-101 was the standard Czechoslovak light bomber, although the A-100 had been largely supplanted in first-line tactical reconnaissance squadrons by the Letov Š-328. The A-100s and Ab-101s transferred to the Slovak Air Force remained in the first-line inventory until 1942, although the Š-328 was the primary tactical reconnaissance type in Slovakian service. Subsequently, the surviving Aero biplanes were relegated to the communications and training roles.



(Left) The Ab-101, a more powerful and heavier derivative of the A-100



AERO Ab-101 (A-100) SPECIFICATION

Type: *Two-seat Light Tactical Reconnaissance Bomber.* **Power Plant:** *One ČKD-Praga-built Hispano-Suiza 12Ydrs (Avia Vr-36) 12-cylinder Vee liquid-cooled engine rated at 860 (725) h.p. at 13,120 (8,200) ft.* **Armament:** *Two fixed forward-firing 7.92-mm. Ceska-Zbrojovka machine guns and two 7.92-mm. machine guns on flexible mounting in observer's cockpit, plus three 220-lb. bombs internally and four 110-lb. bombs externally.* **Performance:** *Maximum speed, 161 (168) m.p.h. at sea level; economical cruising speed, 127 (143) m.p.h.; cruising range, 590 (570) mls.; time to 16,400 ft., 25 (20) min.; service ceiling, 24,605 (21,325) ft.* **Weights:** *Empty, 5,137 (4,497) lb.; loaded, 9,259 (7,099) lb.* **Dimensions:** *Span, 55 ft. 9¼ in. (48 ft. 3 in.); length, 41 ft. 0 in. (34 ft. 9⅛ in.); height, 12 ft. 3 in. (11 ft. 6 in.); wing area, 631.84 (476.84) sq. ft.*

AERO A-304 (CZECHOSLOVAKIA) BOHEMIA-MORAVIA

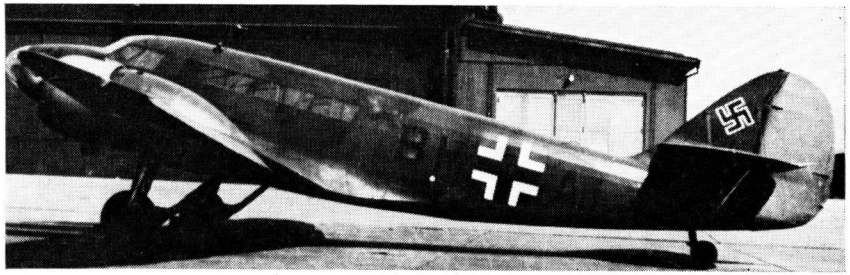
During 1936, the Aero Tovarna Letadel Dr. Kabes produced the prototype A-204 eight-passenger light commercial transport powered by two Walter Pollux IIR nine-cylinder radial engines rated at 400 h.p. for take-off and having a maximum rating of 450 h.p. The promise evinced by the A-204 resulted, in 1937, in the Czechoslovak Ministry of National Defence placing an order for 15 examples of a projected light reconnaissance-bomber derivative, the **A-304**, deliveries of which commenced in the following year.

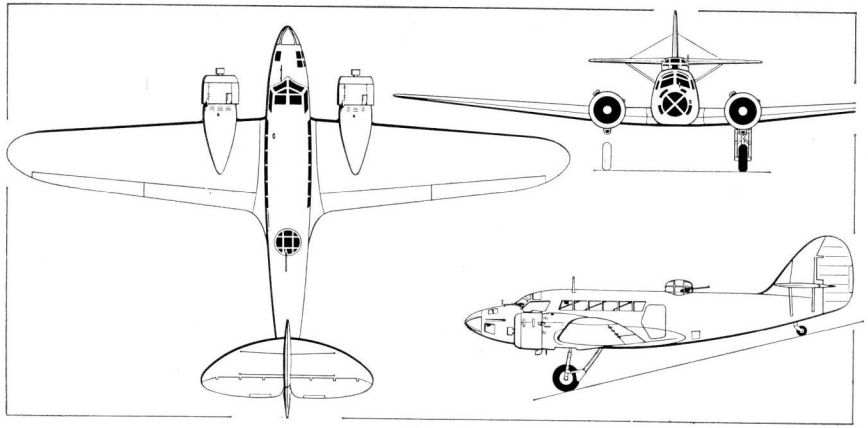
Although the basic structure of the commercial A-204 was retained unchanged, apart from some local strengthening, a glazed nose cone was introduced for the bombardier-observer, a manually-operated turret was provided in the upper decking of the rear fuselage housing a single 7.92-mm. machine gun, a similar weapon was mounted above a hatch in the fuselage floor, and a third was fixed to fire forward in the portside of the nose, and racks were provided for a single 220.5-lb. or 441-lb. bomb beneath the fuselage and two 110-lb. or six 22-lb. or 44-lb. bombs beneath the wings. Provision was made for the installation of one manually-operated reconnaissance camera in the nose and an automatic camera aft, and the Pollux engines were replaced by Super-Castor I-MRs which were supercharged to give 460 h.p. for take-off.

The A-304 was of mixed construction, the the cantilever low-wing being a wooden structure with plywood skinning and the fuselage being a welded steel-tube structure with fabric covering. The duralumin landing flaps and the retractable main undercarriage members were hydraulically operated. All fuel was housed in the wings, total capacity being 203 Imp. gal., and provision was made for the installation of dual controls and a seat for a pupil to starboard of the pilot for the training role.

Delivery of the 15 A-304s had been completed when German forces occupied Bohemia and Moravia, and the aircraft were promptly seized by the *Luftwaffe*. Several had all armament removed and were placed in service by the *Flugzeugführerschule* A/B 71 at Prostějov, near Olomouc, in Moravia, and the remainder were supplied to the Buglarian Air Force in 1941 after Bulgaria signed the Axis Tripartite Pact, equipping a light reconnaissance-bomber squadron that was engaged on coastal patrol until 1943 when the surviving A-304s were relegated to the communications role.

An A-304 light reconnaissance bomber (BH-AI) seen in Luftwaffe service at Prostějov.





AERO A-304 SPECIFICATION

Type: *Three-seat Light Reconnaissance-bomber.* **Power Plants:** *Two Walter Super-Castor I-MR nine-cylinder radial air-cooled engines each rated at* 460 *h.p. for take-off,* 430 *h.p. at* 5,900 *ft., and* 450 *h.p. at* 6,560 *ft.* **Armament:** *One fixed forward-firing* 7.92-*mm. machine gun, one* 7.92-*mm. machine gun in manually-operated dorsal turret, and one* 7.92-*mm. machine gun firing through ventral tunnel, plus one* 220.5-*lb. or* 441-*lb. bomb and two* 110-*lb. or six* 44-*lb. or* 22-*lb. bombs.* **Performance:** (*Without external bomb load*) *Maximum speed,* 186 *m.p.h. at sea level,* 200 *m.p.h. at* 5,740 *ft.; maximum cruising speed,* 180 *m.p.h. at* 5,740 *ft.; maximum range,* 745 *mls.; climb to* 3,280 *ft.,* 4 *min., to* 6,560 *ft.,* 7.5 *min.; service ceiling,* 19,025 *ft.* **Weights:** *Empty* (*Reconnaissance mission*), 6,614 *lb.; normal loaded,* 9,601 *lb.; maximum loaded,* 10,275 *lb.* **Dimensions:** *Span,* 62 *ft.* 11¾ *in.; length,* 43 *ft.* 3¾ *in.; height,* 11 *ft.* 1¾ *in.; wing area,* 486.529 *sq. ft.*

LETOV Š-328 (CZECHOSLOVAKIA) BOHEMIA-MORAVIA

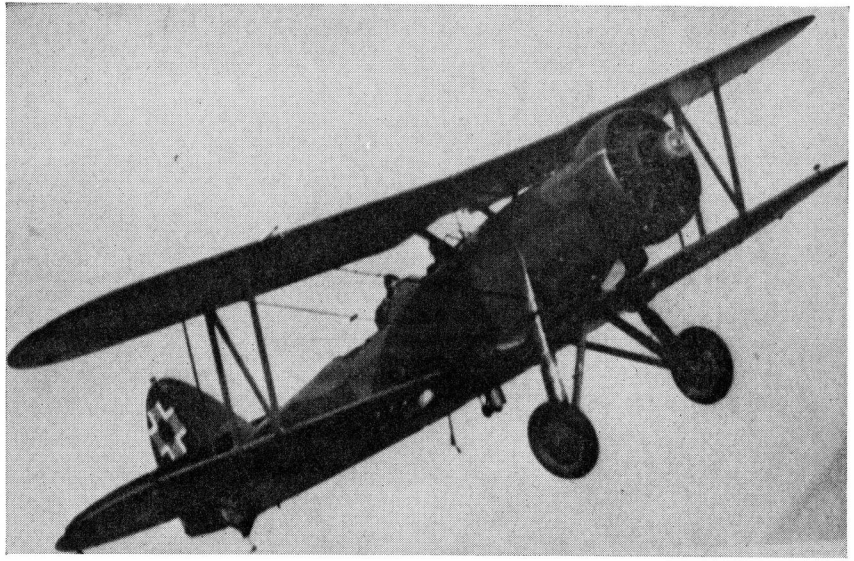
A sturdy, reliable but unremarkable tactical reconnaissance biplane, typical of the early 'thirties in which it was conceived, the Letov Š-328 designed by Alois Šmolik was, nevertheless, destined to experience a surprisingly extensive wartime operational career, and it was to outlive in production aircraft developed as its successors. First ordered into production at Letov's Prague-Letnany factory in 1934, the Š-328 was maintained in continuous production by a succession of orders, and when in March 1939 German troops occupied Bohemia and Moravia, the Š-328 was still on the assembly line and remained so until a total of 450 had been completed.

Evolved from the experimental Š-28 of 1929 and Š-228 of 1931, the **Š-328** light two-seat general-purpose biplane was originally designed to fulfil a Finnish requirement but, in the event, no Finnish order materialised. However, interest evinced by the Czechoslovak Ministry of National Defence crystallized in the form of a production order for the Army Air Force reconnaissance squadrons in 1934, followed, in 1935, by an order for a twin-float seaplane target-tug version, the **Š-328V**. Featuring an all-metal structure covered by fabric apart from the forward fuselage which was covered by light alloy panels, the Š-328 was powered by a Walter-built Bristol Pegasus II.M.2 nine-cylinder air-cooled radial offering 635 h.p. at sea level and 580 h.p. at 5,000 ft. Armament normally comprised a pair of fixed forward-firing 7.92-mm. Ceska-Zbrojovka machine guns in the upper wing, although an additional pair of guns could be mounted in the lower wing. Either one or two weapons of similar calibre were mounted on a Skoda ring mounting in the observer's cockpit, and racks beneath the lower wings could carry either two 264.5-lb. bombs or up to 770 lb. of smaller bombs.

In 1935, a potential production successor to the Š-328 was developed at the Prague-Letnany factory. This, the **Š-528**, was in effect a more powerful version of the basic design with a Walter-built Gnôme-Rhône 14Krsd 14-cylinder radial in a long-chord cowling and developing 800 h.p. at 12,630 ft. Although the Š-528 offered a substantial improvement in performance over the Š-328, only a small series was ordered for the National Air Guard, and further orders were placed on behalf of the Army Air Force for the earlier aircraft.

Production of the Š-328 continued at Prague-Letnany after the German occupation,

An Š-328 serving with one of the Luftwaffe's A/B-Schulen at Olomouc Airfield in 1940



A Letov Š-328 of the Slovakian Air Force's No. 2 Liaison Squadron photographed over the western Ukraine in July 1941. Three Slovak squadrons operated the Š-328

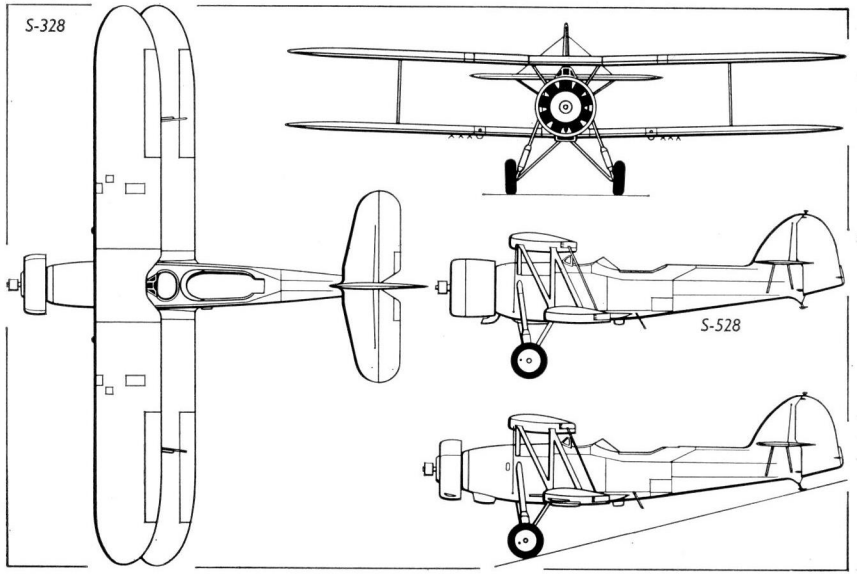
continuing into 1940, among the last to be completed being a batch of 30 for the Bulgarian Air Force.

OPERATIONAL CAREER

Immediately after the occupation of Bohemia and Moravia, Š-328s were pressed into service as trainers with the *Luftwaffe's* A/B-*Schulen*, while others were passed to the newly-created Slovak Air Force. The Slovakian Š-328s performed reconnaissance missions and some bombing sorties, including an attack on Tarnopol, in support of the German invasion of Poland, eventually equipping Nos. 1 and 3 reconnaissance squadrons, and No. 2 liaison squadron. Other Š-328s served with the flying school at Banská Bystrica. With the invasion of the Soviet Union in 1941, the Š-328s of the

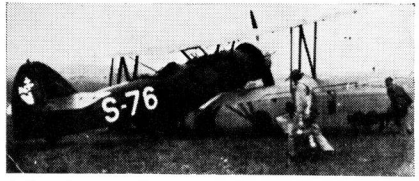
Slovak Air Force again saw active service, all three squadrons equipped with this type operating over Soviet territory, although their activities were largely confined to locating partisan groups in the western Ukraine. With the onset of the winter of 1941–42 they were withdrawn to their home bases of Zvolen and Spisska Nova Ves, but returned to the Eastern Front during the following spring, several defecting to the Russians during the course of subsequent operations.

With the formation of the *Störkampfstaffeln* by the *Luftwaffe* during the winter of 1942–43, the Š-328 was pressed into operational service once more. The forerunners of the *Nachtschlachtgruppen*, the *Störkampfstaffeln* were hurriedly formed to provide an answer to the nocturnal harrassing of the Russian Polikarpov Po-2 light biplanes, and the Š-328s, amongst other types, were crewed by volunteers from the ranks of the A/B-*Schulen* instructors, although most of the Letov biplanes had been

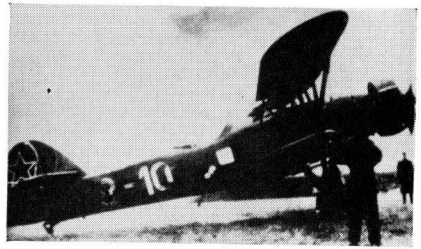


supplanted by later types by the spring of 1943. In Bulgarian service, the Š-328 had been dubbed the *Vrana*, and with the invasion of the Soviet Union and the establishment of the *Aufklärungsführer Schwarzes Meer West* (Reconnaissance Commander Black Sea West), it was decided to include a Bulgarian Š-328 unit under German command despite the fact that Bulgaria was not officially at war with the Soviet Union. The Bulgarian unit, the 161st Maritime Squadron with five Š-328s, was allocated the task of patrolling Bulgaria's Black Sea coastline out to a distance of 62 miles, but the unit did not enjoy any auspicious success owing to the complete lack of co-operation existing between it and the Rumanian element under the same command. By mid-1942, the 161st Squadron's Š-328s had been replaced by Arado Ar 196s, and the biplanes subsequently performed the army co-operation task.

The final active use of the Š-328 came with the Slovak National Uprising that commenced on August 29, 1944. An insurgent air arm was established on the Tri Duby airfield, near Zvolen, and the so-called "Combined Squadron" included a trio of Š-328s which undertook reconnaissance flights for the Slovak insurgent forces until insurgent territory was finally overrun by the *Wehrmacht* late in October.



(*Above*) *One of the three* Š-328*s employed by the Slovak "Insurgent Air Force" at Tri Duby airfield in* 1944 *sporting the insurgent insignia, and* (*below*) *another of the insurgent* Š-328*s at Tri Duby airfield with "Red Star" tail marking*



LETOV Š-328 SPECIFICATION

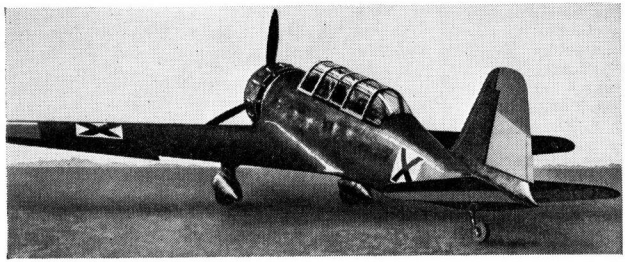
Type: *Two-seat Light Tactical Reconnaissance-bomber.* **Power Plant:** *One Walter-built Bristol Pegasus II. M.2 nine-cylinder radial air-cooled engine rated at* 635 *h.p. at sea level and* 580 *h.p. at* 5,000 *ft.* **Armament:** *Two fixed forward-firing* 7.92-*mm. Ceska-Zbrojovka machine guns in upper wing, and two* 7.92-*mm. machine guns on Skoda ring mounting in rear cockpit, plus two* 264.5-*lb or six* 110-*lb. bombs beneath the wings.* **Performance:** *Maximum speed,* 174 *m.p.h. at* 5,900 *ft.,* 158 *m.p.h. at* 16,400 *ft.; cruising speed,* 152 *m.p.h. at* 4,830 *ft.; normal range,* 435 *mls.,* (*with overload tanks*), 795 *mls.; climb to* 16,400 *ft.,* 17 *min.; service ceiling,* 23,600 *ft.* **Weights:** *Empty,* 3,704 *lb.; loaded,* 5,820 *lb.* **Dimensions:** *Span,* 44 *ft.* 11¾ *in.; length,* 33 *ft.* 11¾ *in.; height,* 10 *ft.* 11 *in.; wing area,* 424.097 *sq. ft.*

From the time of its clandestine formation in the mid-'thirties, Bulgaria's air arm relied primarily on the aircraft industries of Czechoslovakia and Poland for its combat aircraft, purchasing 48 Avia B-534 and 12 Avia B-135 fighters, 30 Letov Š-328 reconnaissance aircraft, six Aero-built Bloch MB-200 and 42 Avia B-71 (SB-2) medium bombers, and a small number of Aero A-304 light bombers from the former, and 24 PZL P.24F fighters and 54 PZL P.43 reconnaissance-bombers from the latter. The small indigenous aircraft industry, which consisted solely of the Darjavna Aeroplanna Rabotilnitza (D.A.R.), or State Aircraft Factory, at Bojourishte, Sofia, concentrated entirely on the manufacture of training aircraft, such as the D.A.R.6A Sinigiert advanced training biplane designed by Prof. Ing. Svietan Lazarov, and the D.A.R.9 primary training biplane, a licence-built version of the Focke-Wulf Fw 44 Stieglitz. However, in 1939 work was initiated on a combat aircraft of indigenous design, the **D.A.R.10** light reconnaissance bomber, the prototype of which was flown at Bojourishte early in 1941.

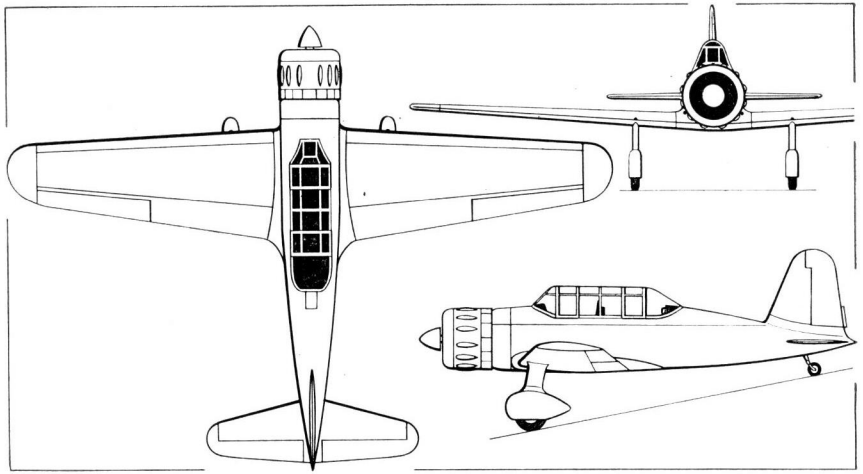
D.A.R.10F SPECIFICATION

Type: *Tandem Two-seat Light Reconnaissance-bomber and Dive-bomber.* **Power Plant:** *One Fiat A.74 R.C.38 14-cylinder radial air-cooled engine rated at 870 h.p. for take-off and 840 h.p. at 12,500 ft.* **Armament:** *Two 20-mm. cannon and two 7.7-mm. machine guns in the wings and two 7.7-mm. machine guns on flexible mounting in rear cockpit, plus one 550-lb. bomb beneath fuselage and four 110-lb. bombs beneath wings.* **Performance:** *(Without external war-load) Maximum speed, 295 m.p.h. at 12,500 ft., 263 m.p.h. at sea level; cruising speed (with external stores), 207 m.p.h. at 12,500 ft.; normal range, 497 mls.* **Weights:** *No details available for publication.* **Dimensions:** *No details available for publication.*

The D.A.R.10 was a low-wing cantilever monoplane of mixed construction with a fixed spatted undercarriage. The fuselage possessed a welded steel-tube structure with light metal skinning, and the wing was a two-spar wooden structure with plywood and fabric skinning. After the completion of prototype trials late in 1941, production of a modified version, the



The D.A.R.10F multi-purpose aircraft was the only combat type of indigenous design produced by Bulgaria



D.A.R.10F was initiated, this carrying a substantially heavier armament and adding the role of dive bomber to the aircraft's repertoire. Limited deliveries of the D.A.R.10F to Bulgaria's air arm began in 1943, but only part of one *Orlek*, or Regiment, re-equipped from the Junkers Ju 87B to this type, the primarily defensive role of the air arm necessitating the Bojourishte plant giving priority over D.A.R.10F manufacture to the overhaul and repair of fighters. Although the Bulgarian air arm had seen limited action in support of the *Luftwaffe* during the invasion of Greece and Yugoslavia in May 1941, its activities were subsequently confined largely to the fighter defence of the principal Bulgarian towns and airfields, apart from the aerial policing of parts of Yugoslavia and actions against Yugoslav partisans in which the D.A.R.10F participated. In August 1944, Russian forces were approaching Bulgarian territory, but Bulgaria was not officially at war with the Soviet Union and declared herself to be "neutral in the Russo–German war". Nevertheless, the Soviet Union declared war on Bulgaria, but the Bulgarian air arm took no action against the Soviet forces entering the country, and the Bulgarian government immediately capitulated, the D.A.R.10F, the only Bulgarian combat aircraft of indigenous design to attain production, thus having no opportunity to prove itself.

In 1941, an extraordinary situation arose in which the R.C.A.F. found itself operating what was ostensibly a fighter squadron on reconnaissance and coastal patrol duties with an aircraft built for the attack role that the service had neither ordered nor wanted. Indeed, but a few months prior to the delivery of the aircraft, the R.C.A.F. was uncertain as to the role that these warplanes would undertake, and was demanding to know from the manufacturer why they were being painted in standard *fighter* finish. In the event, the type concerned, the Canadian Car & Foundry-built Grumman GE-23, was never to see combat with the R.C.A.F., but its story was undoubtedly unique among aircraft that saw first-line operational service with the Allies during World War II.

Officially named Goblin by the R.C.A.F., the GE-23 reached the Canadian service by a most circuitous process. Its origins dated to 1930 when the fledgeling Grumman Aircraft Engineering Corporation broke fresh ground by initiating the design of the **G-23**, a tandem two-seat shipboard fighter biplane which combined fully enclosed cockpits with a retractable undercarriage. Ordered by the U.S. Navy as the XFF-1 on April 2, 1931, the

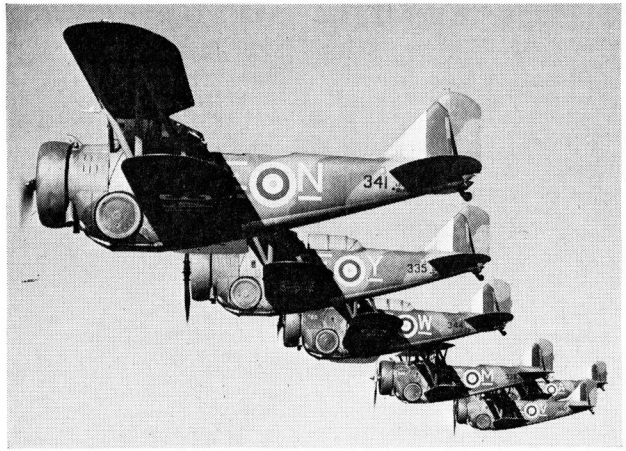
This Goblin (342) *was the first example of its type received by the R.C.A.F., taken on charge on September 17,* 1940, *and used by the Test and Development Flight*

G-23 was delivered on December 29, 1931. It featured an all-metal monocoque fuselage into the sides of which the mainwheels retracted, the wings comprised aluminium alloy spars and ribs with fabric covering, and the metal-framed tail assembly had light-alloy covered fixed surfaces and fabric-skinned rudder and elevators. Powered by a Wright R-1820-E Cyclone nine-cylinder radial rated at 600 h.p. (later supplanted by an R-1820-F of 650 h.p.), the XFF-1 attained 195 m.p.h. at sea level, a substantially higher speed than that attainable by any *single*-seat shipboard fighter then available to the U.S. Navy. This was boosted to 201 m.p.h. in October 1932 with the installation of the more powerful R-1820-F, and on December 19, 1932, the U.S. Navy placed a production order for 27 FF-1s with the 700 h.p. R-1820-78 Cyclone. These were delivered between May and November 1933, and in the latter month a new variant made its début, the XSF-1 equipped for scouting and powered by a 600 h.p. Pratt & Whitney R-1690-C engine. A few weeks later, on December 4th, 34 examples of the SF-1 were ordered with the 725 h.p. Wright R-1820-84 Cyclone, these being delivered during 1934, the last example being experimentally fitted with a 650 h.p. Pratt & Whitney R-1535-80 Wasp driving a controllable-pitch airscrew.

The FF-1s were delivered to Fighting Squadron VF-5B aboard the U.S.S. *Lexington*, the SF-1s going to Scouting Squadron VS-3B also aboard the *Lexington*, but by 1936 the FF-1s had been withdrawn for conversion as FF-2s and re-issued to U.S. Naval Reserve Units in which they were joined by the SF-1s, and the first-line career of the G-23 was over, at least, insofar as those built by the parent company were concerned.

In 1937, the Canadian Car & Foundry, the largest manufacturers of railway equipment in Canada, established an aircraft factory, and as a result of representations made by what were ostensibly representatives of the Turkish government, acquired the manufacturing licence for the G-23 which received the export designation **GE-23**. Preparations were immediately initiated for the construction of a batch of 40 GE-23 biplanes as attack aircraft against an order which was purported to have originated with the Turkish government. The GE-23 was fitted with a Wright R-1820-F52 Cyclone rated at 800 h.p. for take-off and 775 h.p. at 5,800 ft. The first three fuselage shells were manufactured by Grumman and transported to the C.C.F. plant near Montreal, the wings and tail surfaces being produced by the Brewster company, and these served as pattern aircraft, all tools and jigs being transferred to C.C.F.

It is not known if the manufacturers were aware that the true destination of the 40 GE-23s was Republican Spain, although the fact that the aircraft were routed to Istanbul via Le Havre and *Barcelona* should certainly have aroused some suspicions. With their arrival in Barcelona late in 1937, the first GE-23s were hurriedly assembled and had participated in the Teruel battle before the end of the year. They subsequently appeared in the Ebro battle, underwing racks being fitted for light bombs, the GE-23s being used extensively by the Republicans for attack, ground strafing and tactical reconnaissance tasks. The Nationalists claimed to have shot down four GE-23s in aerial combat over the Ebro, and at least two were destroyed on the ground at the Vilajuiga airfield in February 1938. All 40 GE-23s had reached Spain by the autumn of 1938, this attack aircraft being dubbed the *Pedro Rico* by its Nationalist opponents. A further five had been destroyed in aerial combat before the end of 1938, and three more were shot down by the Nationalists during the last months of the Civil War, in

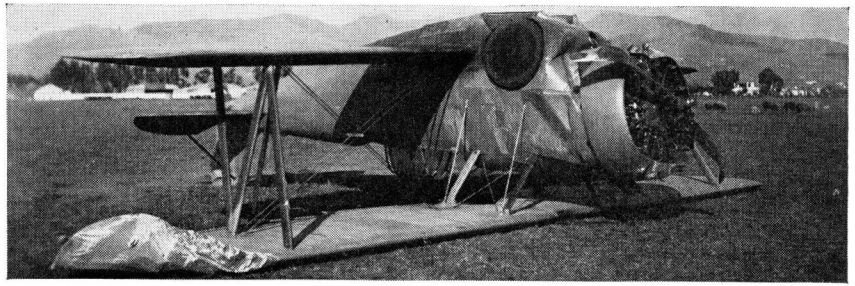


A formation of six Goblins of No. 118 *Squadron flying from Dartmouth, Nova Scotia in* 1941

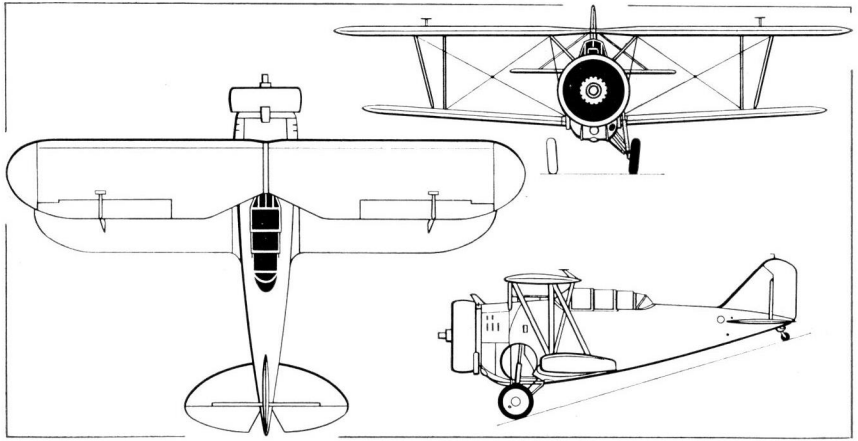
1939, but only eight GE-23s were recovered by the Nationalists after the termination of hostilities and it may be presumed, therefore, that the remainder were either destroyed in attacks on Republican airfields, or were damaged in battle and written off. The eight survivors continued in service for a number of years with Spain's air arm under the name *Delfin* (Dolphin).

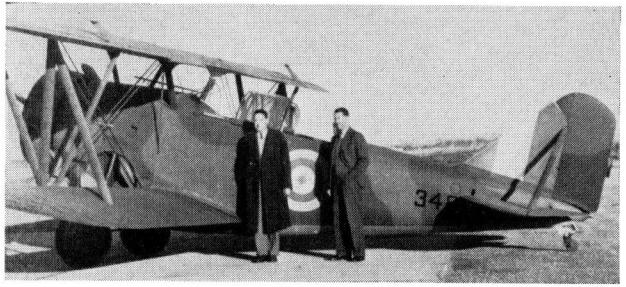
IN CANADIAN SERVICE

Although a decision in principle had been taken in 1938 to manufacture the Hurricane at C.C.F.'s Montreal plant, specifications covering Canadian production of the fighter had not been issued and, in order to keep its work force together, C.C.F. had continued production of the GE-23 after completion of the "Turkish" order, despite the failure of earlier attempts to interest the R.C.A.F. in the aircraft. One GE-23 had been sent to Mexico to serve as a pattern aircraft for use by a proposed C.C.F. manufacturing facility in that country, but when this failed to materialize, the aircraft (c/n 148) was returned to Canada and eventually sold to Nicaragua's *Guardia Nacional*. With growing tension in Europe and major R.C.A.F. expansion plans, one GE-23 (c/n 143) registered CF-BLK was made available to a team of R.C.A.F. pilots for evaluation. This, in itself, created a number of problems, as the GE-23s had been built without the factory having a resident DND (equivalent to the British AID) inspector, and possessed no Certificate of Airworthiness. These facts, coupled with the R.C.A.F. attitude that it did not want the GE-23 at any cost, did not augur well for the eventual acceptance of the aircraft by the Canadian service, despite the exigencies of the times. However, the R.C.A.F. was eventually offered the GE-23 at cost price merely to keep the C.C.F. plant open until Hurricane production could be initiated, and an agreement was



A C.C.F.-built GE-23 serving with Spain's Ejercito del Aire after suffering an accident on January 13, 1942. *The GE-23 was dubbed Delfin in Spanish service*





The last Goblin for the R.C.A.F. (348) *seen with ferry service pilot Douglas Pickering immediately before its delivery flight*

finally reached by which 15 aircraft were purchased.

The R.C.A.F. was then faced with the problem of deciding the role to be performed by the GE-23 which it now named **Goblin**. There was no requirement for an attack aircraft, and the Goblin was considered totally obsolescent as a fighter. It was finally decided to use it as a coastal patrol and reconnaissance aircraft, and all 15 Goblins were finally taken on charge by the R.C.A.F. between September 17 and October 25, 1940, the serial numbers 334 to 348 being allocated to the aircraft. In December 1940, "A" Flight of No. 118 Squadron was formed on Goblins at Rockcliffe, this unit subsequently becoming No. 118 (Fighter) Squadron and transferring to Dartmouth, Nova Scotia, in 1941, its primary task being the patrol of Canada's East Coast. Late in 1941, the Goblins were supplemented by Kittyhawk fighters, but they were not finally replaced until the spring of 1942, two being struck off charge on March 5, 1942 and the remainder on April 21, 1942. Five of the Goblins were flown by No. 123 (Army Co-operation) Squadron for a brief period, but after proposals to equip the aircraft as target-tugs proved impracticable they too were struck off. The C.C.F. plant had assembled an additional four GE-23 airframes in 1941, but these were not delivered to the R.C.A.F., and their ultimate fate is uncertain.

C.C.F. GE-23 GOBLIN SPECIFICATION

Type: *Two-seat Patrol and Reconnaissance Aircraft.* **Power Plant:** *One Wright R-1820-F52 Cyclone nine-cylinder radial air-cooled engine rated at 800 h.p. for take-off and 775 h.p. at 5,800 ft.* **Armament:** *Two 0.3-in. Browning machine guns fixed to fire forward and two 0.3-in. Browning machine guns on flexible mounting in rear cockpit.* **Performance:** *Maximum speed, 216 m.p.h. at 7,000 ft.; maximum cruising speed, 197 m.p.h. at 5,800 ft.; range, 630 mls. at 168 m.p.h.; initial climb rate, 1,620 ft./min.; time to 5,000 ft., 3.1 min.; service ceiling, 23,800 ft.* **Weights:** *Empty, 3,277 lb.; loaded, 4,973 lb.* **Dimensions:** *Span, 34 ft. 6 in.; length, 24 ft. 10 in.; height, 9 ft. 6 in.; wing area, 310 sq. ft.*

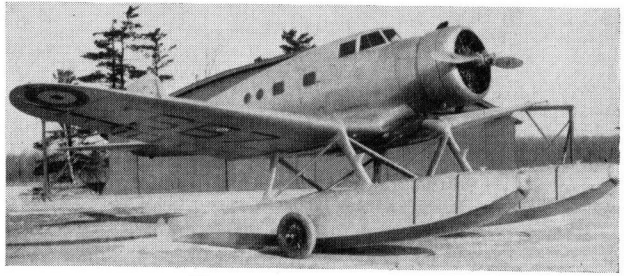
CANADIAN VICKERS (NORTHROP) DELTA

The exigencies of war led to many aircraft being pressed into service in roles for which they had not been originally intended, and one such was the Canadian Vickers-built Northrop Delta which, ordered for photographic survey tasks over Canada's northern territories, was adapted as an armed coastal reconnaissance and patrol aircraft, fulfilling these roles until more suitable aircraft were made available to the R.C.A.F.

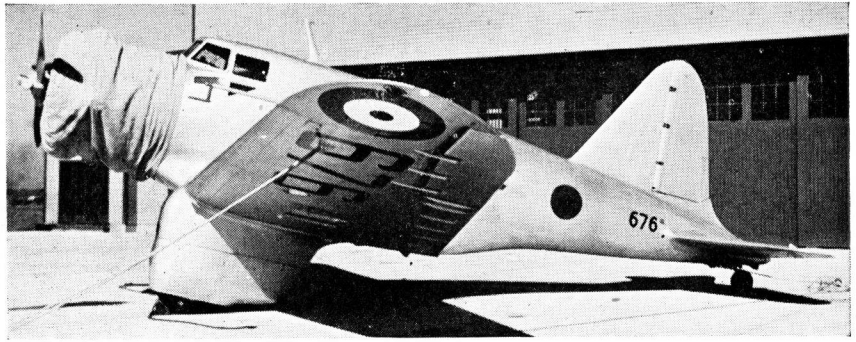
When the Northrop subsidiary of the Douglas Aircraft Company produced the Delta 1-D in 1935 as an eight-passenger derivative of the Gamma 2-D mailplane, the Canadian Department of National Defence immediately evinced interest in the aircraft for photographic survey duties, but the decision to manufacture the Delta under licence in Canada presented Canadian Vickers Limited of Montreal no small task, for this company, awarded the production contract for the Northrop aeroplane, had no background of experience in the construction of all-metal stressed-skin aircraft. Indeed, the Delta was to be the first such aircraft produced in Canada.

The structure of the Delta was as advanced as any of its period. Its monocoque fuselage was built as upper and lower halves, the latter being produced integral with the stub wing centre section, and the wings were so-called multi-cellular structures with no major load-bearing members. The metal-framed fabric-covered ailerons were of slotted type, and manually-operated split flaps were fitted. All fuel was housed in the wing centre section, six tanks having a total capacity for 273 Imp. gal., and power was provided by a Wright SR-1820-F52 Cyclone nine-cylinder air-cooled radial driving a two-bladed Hamilton Standard variable-pitch airscrew. Relatively few changes to the structure were made by Canadian Vickers, although doubts concerning the efficacy of the Northrop-type integral fuselage-skin stiffening led to the provision of conventional separate stiffeners riveted on, and the oleo-pneumatic legs of the undercarriage were lengthened and provision made for replacing the wheels by Vickers Type F streamlined skis or Vickers Type 75 floats. The number of cabin windows was reduced, and provision was made for the installation of a trio of Fairchild A3 automatic cameras in the rear of the cabin.

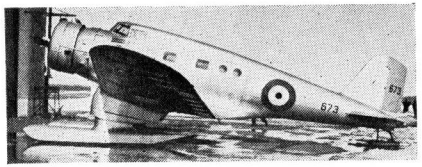
The first aircraft built against an initial



The first Delta I (667) *in the form in which it was originally delivered to the R.C.A.F.*



(Above) The seventh production Delta II (676) after redesign of vertical surfaces with which it became the first Delta III, and (below) the fourth Delta II on skis



contract for three **Delta I** aircraft (667) was flown at Longueuil, Quebec, on August 16, 1936, being delivered to the R.C.A.F. at Rockcliffe two weeks later, on September 1st. Like the two Delta Is (668 and 669) that were delivered on October 17 and October 31, 1936 respectively, the first aircraft was delivered in floatplane configuration, these entering service with No. 8 General-Purpose Squadron, and No. 6 General-Purpose Detachment. In the meantime, work had begun on an initial batch of production aircraft designated **Delta IIs**, the trio of pre-production Delta Is having been assembled partly from U.S.-supplied components.

The first four Delta IIs (670–3) were delivered to the R.C.A.F. in November 1937, these featuring additional windows in the cockpit sides, small windows in the cockpit floor, and, in view of increasing world tension, provision for armament. Subsequently, the three Delta Is were returned to Canadian Vickers for installation of the additional windows with which they became known as Delta IAs. Five more Delta IIs were delivered to the R.C.A.F. during the winter of 1938–39, four of these (674, 676–7 and 682) being delivered to No. 8 General-Purpose Squadron, and one (675) being delivered to No. 1 Fighter Squadron for use as a conversion trainer for future Hurricane pilots.

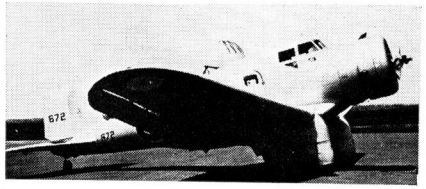
By this time, orders had been placed with

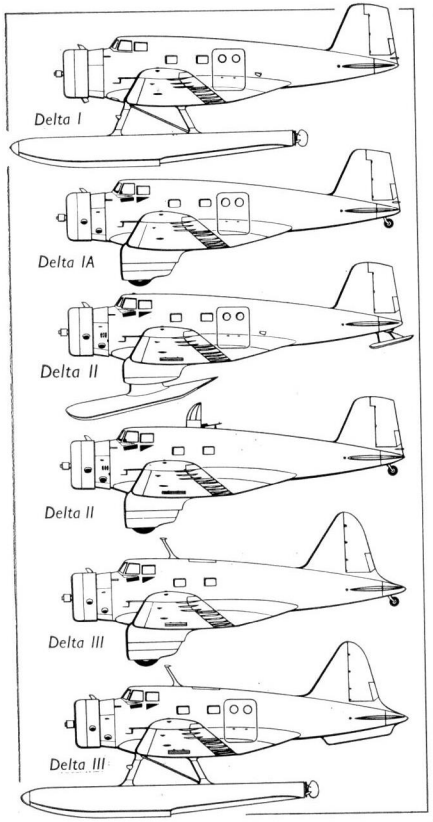
Canadian Vickers for 20 Deltas, including the three pre-production aircraft, and 12 had been delivered to the R.C.A.F., the majority of these going to No. 8 Squadron which operated its Deltas in self-contained mobile detachments, each with two aircraft and six personnel, No. 6 Squadron supplying communications and logistics support. The Deltas were flown with wheels, floats and skis, and proved well suited to operation in the rigorous northern climate, but they were destined to enjoy relatively brief careers in their intended role as photographic survey aircraft.

Owing to the unpreparedness of the R.C.A.F., it became necessary to adapt every suitable aircraft for defensive tasks as the likelihood of war increased, and, accordingly, earlier plans to provide the Delta with armament for coastal patrol and reconnaissance missions were put into effect. The original scheme had been to mount a single 0.3-in. Browning machine gun in each wing, install a semi-enclosed dorsal gun position mounting a similar weapon, and cut a hatch in the floor from which was to be fired a further machine gun. In the event, the ventral gun was dispensed with, but the first and third Delta IIs (670 and 672) were returned to Canadian Vickers for the trial installation of the dorsal gun and the attachment of bomb racks. The latter could lift a single 250-lb. bomb beneath each wing, and four 20-lb. bombs could also be carried beneath the centre section when the aircraft was flown from wheels or skiis. The dorsal position comprised a flexible mounting for a single 0.3-in. machine gun with a transparent half-cone, or turtle-back fairing protecting the gunner from the slipstream. To facilitate the installation of the dorsal gun, the upward-hinging cargo door in the fuselage portside was removed and the aperture filled.

Flight trials with the modified aircraft were extremely disappointing. It was discovered that the drag from the turtle-back fairing seriously affected performance and, furthermore, resulted in severe tail buffeting. Redesign of the vertical tail surfaces was immediately initiated to eradicate the buffet problem but, in September 1939, instructions were issued to dispense with the turtle-back fairing and replace it with a glazed, flush-fitting hatch. Despite the fact that the new tail surfaces had been designed primarily to eliminate buffet resulting from the turtle-back fairing, and the source of this problem had now been removed, the seventh production Delta II (676) was returned to Canadian Vickers late in 1939 to be fitted with the new tail surfaces with which it was redesignated **Delta III**. During the following spring, this aircraft performed spinning trials with the new tail which was also fitted to the next two production aircraft (683 and 684) completed during the summer of 1940, and although it was discovered that the new tail provided insufficient side area when the aircraft were flown as floatplanes, necessitating the provision of an auxiliary ventral fin when floats were fitted, the final six production aircraft (685–690) were completed with the new tail surfaces as Delta

The third Delta II (672) with the experimental semi-enclosed dorsal gun position which was tested on two aircraft but discarded owing to the effect on performance



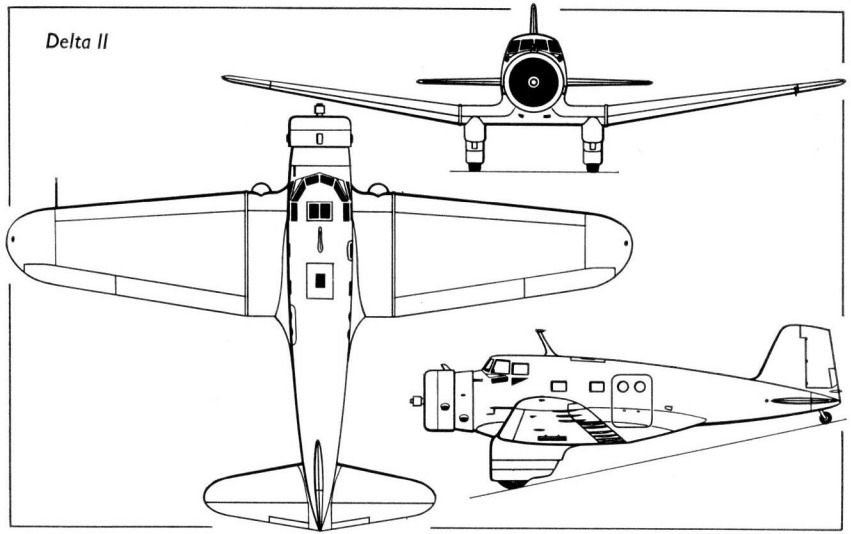


IIIs, the last of these being taken on charge in October 1940.

OPERATIONAL CAREER

On August 24, 1939, No. 8 General-Purpose Squadron was ordered to recall all Deltas from detached photo-survey operations, these hurriedly being fitted with armament and floats. Three days later, six of the Deltas (669, 671, 672, 673, 676 and 677) were despatched to Sydney, Nova Scotia, to initiate coastal patrols, the unit shortly afterwards being redesignated No. 8 Bomber-Reconnaissance Squadron. The Deltas undertook long anti-submarine patrols far out to sea, some of these lasting as long as six hours. The Deltas suffered badly as a result of excessive loads imposed on them by ocean swell which often distorted wing spar webs, and from corrosion, and a major problem was provided by the malfunctioning of bomb release and other mechanisms as a result of salt spray freezing on them. After some two months operations, No. 8 Squadron's Deltas were returned to Canadian Vickers for repair, overhaul and modification to the latest standards, and fitted with wheel undercarriages, these were flown back to the airfield at North Sydney.

During the summer of 1940, a further eight Deltas were delivered to the R.C.A.F., but in No. 8 Bomber-Reconnaissance Squadron they were progressively phased out in favour of the Bolingbroke. Two Deltas (670 and 676) were employed briefly by No. 119 Bomber-Reconnaissance Squadron at Sea Island, Vancouver, but all 1940 production aircraft (683–690) were issued to No. 120 Bomber-Reconnaissance Squadron operating from Patricia Bay. However, few Deltas were still airworthy by late 1941, and it was finally decided to relegate all aircraft of this type to training schools as instructional airframes, seven surviving in this role until February 1945 when the last example was struck off.



CANADIAN VICKERS (NORTHROP) DELTA II SPECIFICATION

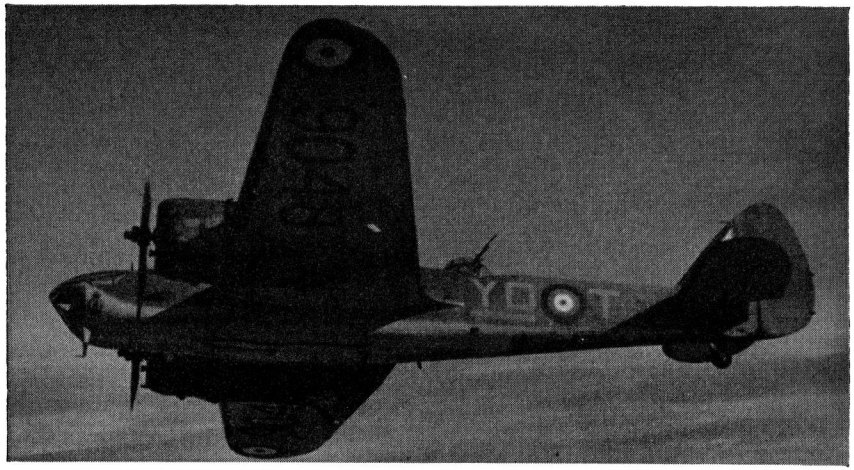
Type: *Three-seat Coastal Patrol and Reconnaissance-bomber.* **Power Plant:** *One Wright SR-1820-F52 Cyclone nine-cylinder radial air-cooled engine rated at 665 h.p. for take-off and 640 m.p.h. at 6,000 ft.* **Armament:** *One 0.3-in. machine gun on flexible mounting fired from dorsal hatch and (some aircraft) two 0.3-in. machine guns in wings, plus (landplane) two 250-lb. bombs and four 20-lb. bombs, or one 250-lb. and eight 20-lb. bombs.* **Performance:** *(Landplane) Maximum speed, 220 m.p.h. at 8,000 ft.; maximum cruising speed, 198 m.p.h. at 15,000 ft.; normal endurance, 5.5 hr.; maximum endurance, 9.25 hr.; initial climb rate, 1,280 ft./min.; service ceiling, 22,100 ft.; (floatplane) maximum speed, 180 m.p.h. at 8,000 ft.; maximum cruising speed, 162 m.p.h.; service ceiling, 19,800 ft.* **Weights:** *Empty (landplane), 4,709 lb., (floatplane), 4,900 lb.; loaded (landplane), 7,350 lb., (floatplane), 7,500 lb.* **Dimensions:** *Span, 47 ft. 9½ in.; length, 33 ft. 1 in.; wing area, 363 sq. ft.*

By 1937, the Canadian government, having accepted the need to modernize and expand the Royal Canadian Air Force, realized that there was also need for concomitant expansion in the scope of Canada's diminutive aircraft industry. In formulating plans for the expansion of the industry, it was agreed that one of the cornerstones of the programme should be the licence manufacture of a modern reconnaissance-bomber, and in conformity with the prevailing Canadian governmental procurement policy of acquiring the bulk of Canada's military equipment from Britain, it elected to produce a derivative of the Bristol Blenheim which, if to prove a somewhat ineffective weapon in the hard school of war, was at that time considered among the most advanced warplanes extant.

The existing Type 142M Blenheim was somewhat short on range to meet Canadian requirements, and the curiously short fuselage nose so characteristic of the bomber did not render it exactly ideal for what in Canadian service was to be primarily a reconnaissance and maritime patrol role. Fortuitously, the British Air Ministry had already given its support to the development of a Blenheim variant in which additional fuel was to be provided by installing tanks in the outer wing panels, and space made available in the extreme nose for a station for a radio-operator/navigator by moving the entire windscreen, complete with the bombardier's window, bodily forward by 3 ft. Allocated the designation Type 149 and dubbed Bolingbroke, this was considered by the British Air Ministry as an interim general reconnaissance aircraft pending availability of the Type 152 which was to enter service as the Beaufort.

An early production Type 142M Blenheim airframe (K7072) was modified to serve as a prototype, this duly flying on September 24, 1937 as the Bolingbroke I. Inadequate vision for the pilot had led to the windscreen being moved aft to its original position, the forward transparent hooding being lowered below the pilot's line of vision, but as view for landing still left something to be desired, the forward hooding on the portside was scalloped, endowing the nose with an asymmetric appearance. In this form, the Bolingbroke was adopted for the R.C.A.F., an initial contract for 18 aircraft being awarded the Fairchild Aircraft Company at Longueuil, Quebec. Meanwhile, however, the British Air Ministry had decided that, in view of the almost total commonality of component parts between the Blenheim and the Bolingbroke, the Type 149 should be renamed Blenheim IV. The R.C.A.F., on the contrary, preferred to retain the original appellation, and thus, although the models manufactured in the two countries were to be externally almost indistinguishable, the Type 149 entered production in Britain as the Blenheim IV and in Canada as the Bolingbroke.

Of nine Blenheim IVs earmarked for the R.C.A.F. as evaluation and pattern aircraft from 1938 British production contracts, only four were destined to reach Canada, where, in the meantime, work had begun on the initial batch of 18 **Bolingbroke Is** (702–719) with the aid of Bristol drawings and many proprietary items and components imported from Britain. Simultaneously, work was proceeding at Longueuil on adapting the Bolingbroke to American structural and equipment standards, and more specifically to Canadian operating requirements. The latter dictated the introduction of de-icing boots on the wing and tail surfaces, the provision of space for dinghies, more extensive radio equipment, and

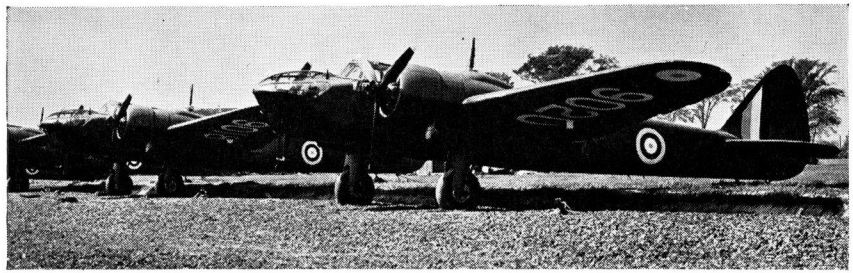


Bolingbroke IV (9048) *of No.* 8 *Bomber-Reconnaissance Squadron photographed over Alaska in the Spring of* 1942 *when this unit was detached from the Western Air Command to support U.S. forces*

interchangeable wheel and ski undercarriages.

A mid-wing cantilever monoplane with a light alloy monocoque fuselage and a stressed-skin wing with spars built up of two heavy steel flanges with light Alclad web between, the Bolingbroke I was a three-seater powered by two Bristol Mercury VIII nine-cylinder radials each rated at 725 h.p. for take-off and offering a maximum output of 840 h.p. at 14,000 ft. Armament comprised a single fixed forward-firing 0.303-in. Browning gun in the port wing and a single Vickers "K" gun of similar calibre in a semi-retractable hydraulically-operated Bristol B.I Mk.III dorsal turret. Two 500-lb. or four 250-lb. bombs could be carried in the fuselage bay below the wing spars.

Fairchild production of the Bolingbroke was relatively slow in getting under way, the first Bolingbroke I (702) not reaching the R.C.A.F. until November 15, 1939, and the 18th and last example of this initial model (719) eventually being taken on charge on August 28, 1940. Several of the aircraft were delivered to No. 8 (Bomber Reconnaissance) Squadron at Sydney, Nova Scotia, where they replaced Canadian Vickers-built Deltas in the maritime patrol role, and others served in



A line-up of Twin Wasp Junior-powered Bolingbroke IVW (9020 *in foreground*) *prior to delivery to Nos.* 8 (*three aircraft*) *and* 119 (*seven aircraft*) *Sqdns*

various development roles. For example, the fifth production Bolingbroke I (705), which was taken on charge by the R.C.A.F. on February 26, 1940 and crashed shortly after delivery, was rebuilt with U.S. equipment and instrumentation as the sole **Bolingbroke II**. and becoming, in effect, the prototype of the definitive Fairchild-built Bolingbroke IV. The 16th production aircraft (717) was completed with a pair of Edo metal floats for evaluation as a seaplane, being taken on charge on August 8, 1940 as the **Bolingbroke III**. This aircraft was subsequently reconverted to landplane configuration, although the first production Bolingbroke I (702), after serving with No. 8 (BR) Sqdn., was to be modified to floatplane configuration in 1942. Two other Bolingbroke Is (712 and 718) were eventually modified as dual-control pilot trainers, while, in 1941, four others were passed to No. 115 (Fighter) Squadron at Montreal.

BOLINGBROKE IV

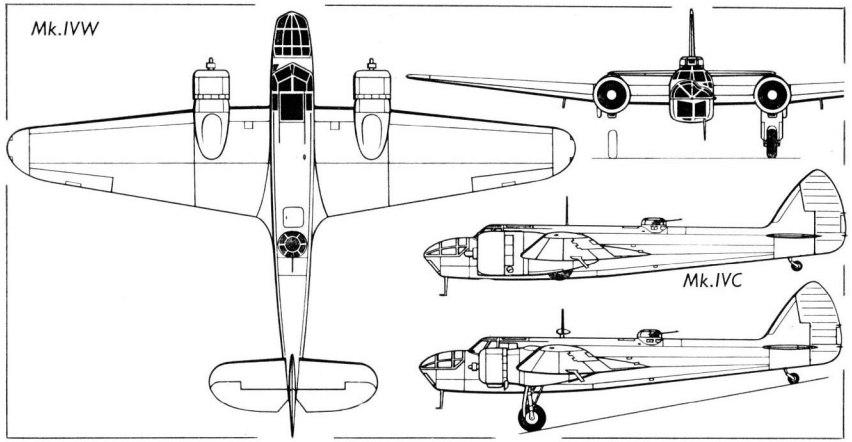
Deliveries of the definitive Bolingbroke IV did not commence until the end of 1940, the first example of this type (9001) being taken on charge by the R.C.A.F. on January 30, 1941, and delivered to No. 8 (BR) Squadron. This first production Mk.IV had attachment points for floats, but this requirement had already been waived and subsequent aircraft did not include this feature. Apart from having largely U.S. equipment and various changes specified by the R.C.A.F. to meet its operational requirements and Canadian climatic conditions, the Bolingbroke IV differed from the Mk.I in having Mercury XV engines each offering 905 h.p. for take-off and 995 h.p. at 9,250 ft., but the ever-present fear that U-boat activity in the Atlantic would interrupt supplies of the British engine had led to an investigation of the possibility of installing the Pratt & Whitney R-1830-SB4G Twin Wasp Junior 14-cylinder two-row radial rated at 825 h.p. for take-off.

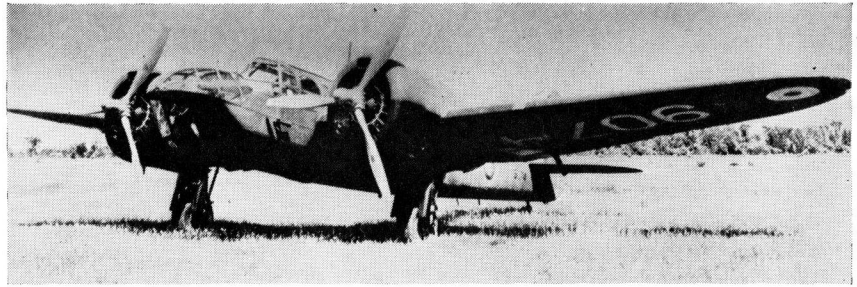
The fifth Mk.IV airframe (9005) was selected to receive Twin Wasp Junior engines as the **Bolingbroke IVW**, and a further 14 aircraft (9010–23) were completed to similar standards, all being taken on charge by the R.C.A.F.

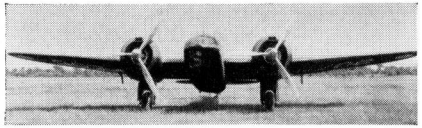
during July and August 1941, the majority of them being issued to Nos. 8 and 119 Bomber Reconnaissance Squadrons. In the event, supplies of Mercury engines never faltered, and no further Bolingbroke IVWs were produced, production continuing with the standard Mk.IV until March 1942 when the 134th aircraft of this type (9001–4, 9006–9, 9024–73, and 9075–151) was taken on charge. A considerable proportion of these had been delivered to Nos. 8, 119 and 147 Bomber Reconnaissance Squadrons. Others had been supplied to Nos. 121 and 122 Composite Squadrons, but by mid-1941, the fact that the Bolingbroke IV was obsolescent as a combat aircraft was appreciated, and as aircraft came off the line they were progressively diverted to training units, including Nos. 3 and 5 Operational Training Units and Nos. 1, 3, 4, 6 and 10 Bombing and Gunnery Schools. The original contract for 18 Bolingbrokes had been supplemented by contracts for a further 200 by the end of 1939, but the final 50 of these (9152–201) were cancelled, although, in the event, they were to be reinstated at the end of the production run as Bolingbroke IVT trainers.

Two Bolingbroke IVs (9071 and 9073) were converted as dual-control pilot trainers in July and November 1942 respectively, and another (9086) was used for trials with a ski undercarriage, this being the first use of skis with the Bolingbroke despite the fact that all aircraft of this type were capable of accepting such an undercarriage.

Although no shortage of Mercury XV







(Above and left) The sole Bolingbroke IVC (9074) with Cyclone GR-1820-G3B engines. First flown on June 29, 1942, the Mk.IVC was extensively tested but offered little improvement over the Mercury-powered Bolingbroke, and no production was undertaken

engines transpired, there was a shortage of 100-octane fuel, and take-off performance with the readily-available 93-octane fuel was not all that it might have been. An early production Mk.IV airframe (9074) was taken from the assembly line and modified to take a pair of Wright Cyclone GR-1820-G3Bs for comparison purposes. Rated at 900 h.p. for take-off, the Cyclones marginally improved take-off, but these large-diameter nine-cylinder radials severely restricted the pilot's view, and although tests, which started on June 29, 1942, continued for some time, no further **Bolingbroke IVC** aircraft, as the Cyclone-powered conversion was designated, were produced. Six months earlier, a Bolingbroke IV (9085) had been flown with Mercury XX engines in place of the standard Mercury XVs. The Mercury XX offered 820 h.p. for take-off and gave a maximum output of 870 h.p. at 4,500 ft. This version of the engine operated at lower revs and was intended specifically for lower-octane fuel. Nevertheless, the next production version of the Bolingbroke, the Mk.IVT bombing, gunnery and navigational trainer which succeeded the reconnaissance-bomber variant on the assembly line early in 1942, retained the Mercury XV as substantial stocks of this engine had been built up in the meantime, and it was not until the spring of 1943 that the Bolingbroke IVT switched to the Mercury XX★ which embodied some modifications to suit it for Canadian operating conditions, this power plant being installed in the final 107 production aircraft delivered between May and November 1943.

By the summer of 1942, production of the **Bolingbroke IVT** at Longueuil had attained a rate of 15 per month, and tempo steadily increased, a total of 350 Mercury XV-

powered Bolingbroke IVTs (9850–99, 9900–99 and 10000–199) being delivered between March 1942 and May 1943, these being followed by 107 Mercury XX★-powered aircraft (10200–56 and 9152–201) to bring total Bolingbroke IVT production to 457 aircraft. An additional 51 airframes were manufactured at Longueuil but not taken on charge and eventually reduced to scrap.

Two Bolingbroke IVTs (10165 and 10166) were completed as radio-operator trainers, seven were later converted as dual-control pilot trainers, and a substantial number were adapted as target tugs. For gunnery training, a number of Bolingbroke IVTs had their Bristol B.I Mk.III or IIIA dorsal turret replaced by a Boulton Paul Type "C" turret with twin 0.303-in. Brownings.

The Bolingbroke remained in service as a target tug, and for pilot, navigational, bombing and gunnery training with schools participating in the British Commonwealth Air Training Programme until this officially terminated in March 1945, serving with Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 31 Bombing and Gunnery Schools, and Nos. 1, 5, 7, 8, 31, 34 and 35 Operational Training Units. Its first-line operational service with the R.C.A.F. was relatively short and not particularly auspicious, serving with both the Eastern and Western Air Commands, but by the time the U-boat menace began to reach really serious proportions, the Bolingbroke had given place to more suitable longer-endurance aircraft. One Bolingbroke IV-equipped squadron, No. 8 (BR) Squadron, was detached from the Western Air Command at the height of the crisis in the Pacific, in the spring of 1942, to operate over Alaska and the Aleutians, assisting U.S. forces in checking a Japanese attack from that direction, and performing patrol and strafing missions in that isolated theatre, but otherwise the Bolingbroke saw little active service. Obsolete by the time it joined the R.C.A.F., it was not ideally suited to that service's requirements and, in consequence, was not a popular machine, its reputation suffering more than was justified as a result of difficulties with the Mercury engines experienced under the rigorous Canadian climate. But if the Bolingbroke did not prove itself an outstanding warplane, it was one of the handful of aircraft on which Canada's aircraft industry cut its teeth, and possesses, therefore, an important place in the history of Canadian aviation.

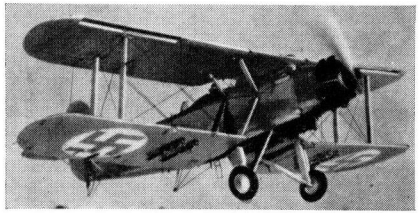
FAIRCHILD (BRISTOL) BOLINGBROKE IV SPECIFICATION

Type: *Three-seat Patrol and Reconnaissance-bomber.* **Power Plants:** *Two Bristol Mercury XV nine-cylinder radial air-cooled engines each rated at* 905 *h.p. for take-off and* 995 *h.p. at* 9,250 *ft.* **Armament:** *(Defensive) One fixed forward-firing* 0.303-*in. Browning machine gun and one* 0.303-*in. Vickers "K" machine gun in power-operated dorsal turret. (Offensive) Two* 500-*lb. or four* 250-*lb. bombs.* **Performance:** *Maximum speed,* 238 *m.p.h. at sea level,* 255 *m.p.h. at* 5,000 *ft.,* 270 *m.p.h. at* 10,000 *ft.,* 288 *m.p.h. at* 15,000 *ft.; cruising speed,* 200 *m.p.h. at* 10,000 *ft.; economical cruising speed,* 170 *m.p.h.; maximum range,* 1,860 *mls. at* 170 *m.p.h.,* 1,520 *mls. at* 200 *m.p.h.; initial climb rate,* 1,480 *ft./min.; service ceiling,* 27,000 *ft.* **Weights:** *Empty,* 9,835 *lb.; normal loaded,* 13,750 *lb.; maximum loaded,* 14,500 *lb.* **Dimensions:** *Span,* 56 *ft.* 4 *in.; length,* 42 *ft.* 9 *in.; height,* 9 *ft.* 10 *in.; wing area,* 469 *sq. ft.*

V.L.-BLACKBURN RIPON IIF

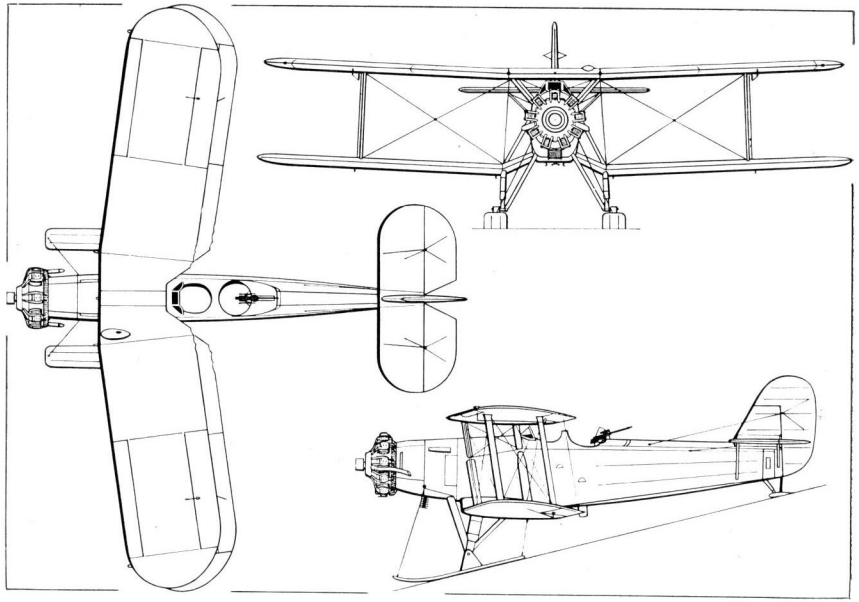
FINLAND

With the dawn of the 'forties it was accepted almost universally that the era of the combat biplane was past. Even the traditionalists who, throughout the late 'thirties, had decried the poorer manoeuvrability and higher landing speeds of the monoplane and insisted that there was still a place for warplanes of biplane configuration in the active inventories of the world's air arms, tacitly admitted that, apart from certain shipboard roles, the biplane was outmoded. The biplane *was* obsolete but a suitable monoplane was not always readily available to replace it, with the result that many of these relics of a past era soldiered on in operational roles. One of the oldest of these must surely have been the Ripon IIF of the Finnish Air Force which saw considerable wartime service on wheels, floats and skis.

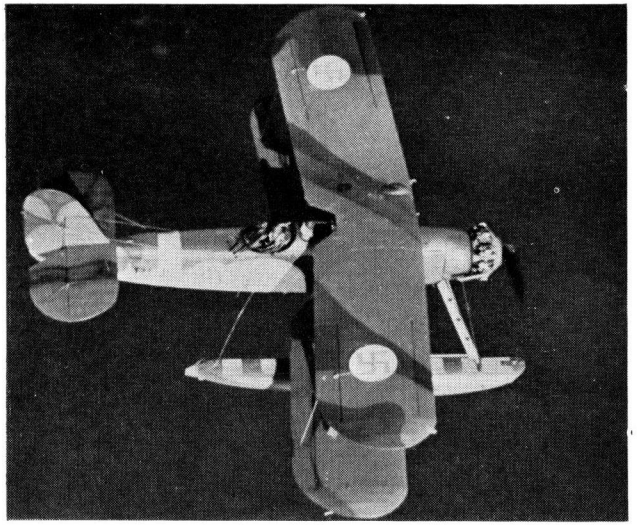


Conceived in 1925 as a two-seat shipboard torpedo-bomber and reconnaissance aircraft, the Ripon made its début in the following year when two prototypes were tested, one as a landplane and the other as a floatplane. Subsequently to be referred to as Ripon Is, these prototypes were built principally of wood and were powered by the liquid-cooled Napier Lion V engine, being followed by a further prototype in 1928, the refined Ripon II with the more powerful Lion XI engine. The Ripon II attracted considerable attention and was promptly ordered into production for the Royal Navy as the Ripon IIA and, in August 1928, the Finnish government placed an order with the Blackburn Aeroplane & Motor Company for one aircraft of this type powered by a 480 h.p. Gnôme-Rhône Jupiter VI 9Ak nine-cylinder radial air-cooled engine, simultaneously acquiring a manufacturing licence.

(Above and below) Pegasus-engined Ripon IIF aircraft operating with T/LeLv 16 *during the winter of* 1939–40. *At this time* 11 *Ripon IIFs were Pegasus-engined*



Dubbed **Ripon IIF**, the Finnish aircraft was, like the production Ripon IIA for the Royal Navy, of composite construction, the wings having metal spars and ribs with fabric cover-



A Ripon IIF floatplane operated by T/LeLv 6 on coastal reconnaissance, anti-submarine patrols and shipping strikes during both the "Winter War" and the "Continuation War"

ing, and the fuselage being of steel-tube construction to a point immediately aft of the cockpits with a wooden rear section, but whereas the Royal Navy version had the liquid-cooled Lion engine, the Finnish production model standarized on the 600 h.p. Armstrong Siddeley Panther IIA 14-cylinder radial air-cooled engine, and wing folding, arrester gear and other specialized naval equipment were deleted.

The Blackburn-built Ripon IIF (RL-121) was delivered to the Finnish Air Force on September 20, 1929, nine months behind schedule, and in the meantime, the *Valtion Lentokonetehdas* (V.L.), the State Aircraft Factory, which had received production drawings from the parent company in August 1929, had begun preparations for licence manufacture, completing its first Ripon IIF late in 1930. A further 15 Panther-powered Ripon IIFs were built by the V.L. in 1931, but some of these aircraft were later to be re-engined with the Pegasus.

The Ripon IIF was intended primarily for coastal reconnaissance and patrol, and, issued to the seaplane squadrons at Santahamina, Turkinsaari, and Sortavala, was fitted with V.L.-manufactured floats. Armament comprised one fixed forward-firing 0.3-in. Vickers machine gun and twin Lewis guns of similar calibre on a Scarff ring in the observer's cockpit. Racks were provided beneath the wings and fuselage for either four 220.5-lb. bombs or two 441-lb. depth charges and four 55-lb. bombs. Production of the Ripon IIF was resumed by the V.L. in 1934 with a further batch of 10 aircraft, these being powered by the Bristol Pegasus II-L3 or -M3, respectively low- and medium-supercharged nine-cylinder radials, the former offering maximum power of 650 h.p. at 2,500 ft. and intended for the float version, and the latter giving 635 h.p. at 6,500 ft. and being intended for the landplane version which could be fitted with either skis or wheels.

OPERATIONAL CAREER

In Finnish service the Ripon IIF proved itself a rugged and reliable aircraft, but by November 30, 1939, when the Soviet Union attacked Finland, it was totally obsolete. At that time, a total of 21 Ripons remained on strength, of which one was undergoing servicing at the Air Force Depot and five were being overhauled by the V.L. Of the remaining 15, nine were operating as landplanes with T/LeLv 16, a reconnaissance-bomber squadron based at Värtsilä and attached to the *IV Armeijakunta*, or 4th Army Corps, and six equipped with floats being on the strength of T/LeLv 36 at Kallvik, a sea reconnaissance squadron intended to co-operate with naval units in the Gulf of Finland.

By this time, the Vickers and Lewis guns had been replaced by 7.62-mm. L-33 machine guns, but owing to their extreme vulnerability, the Ripon IIFs of T/LeLv 16 were confined to nocturnal activities, performing night bombing and reconnaissance missions and leaflet-dropping sorties. With the end of hostilities on March 30, 1940, only four Ripons had been written off but the only airworthy examples were the six floatplanes of T/LeLv 36 which had seen no combat, the remaining 11 machines being under repair. When hostilities were resumed on June 22, 1941, T/LeLv 16 had re-equipped with Fokker C.Xs, Lysanders and Gladiator IIs, but T/LeLv 6, which was formerly T/LeLv 36, continued to operate Ripon IIF floatplanes alongside four Dornier Do 22/See and three Høver M.F.11 floatplanes on anti-submarine patrols, anti-shipping strikes and coastal reconnaissance. The Ripon landplanes were largely relegated to non-operational tasks, such as communications and ambulance duties, and on December 15, 1944, the last surviving *Ripu*, as the Ripon IIF was nicknamed in the Finnish Air Force, was finally grounded.

V.L.-Blackburn Ripon IIF
Specification
(Landplane)

Type: *Two-seat Reconnaissance-Bomber and Army Co-operation Aircraft.* **Power Plant:** *One Bristol Pegasus II-M3 nine-cylinder radial air-cooled engine rated at* 635 *h.p. at* 6,500 *ft.* **Armament:** *One fixed forward-firing* 7.62-*mm. L-*33 *machine gun and similar weapon on flexible mounting in observer's cockpit, plus four* 55-*lb. and four* 220.5-*lb bombs or two* 441-*lb. depth charges.* **Performance:** *Maximum speed,* 135 *m.p.h. at* 6,560 *ft.; maximum cruising speed,* 114 *m.p.h. at* 4,920 *ft.; economical criusing speed,* 93 *m.p.h.; maximum range,* 450 *mls.; endurance at economical cruising speed,* 5 *hr.* **Weights:** *Empty,* 4,182 *lb.; loaded,* 7,610 *lb.* **Dimensions:** *Span,* 45 *ft.* 7¼ *in.; length,* 37 *ft.* 11½ *in.; height,* 13 *ft.* 9⅛*in.; wing area,* 686.199 *sq. ft.*

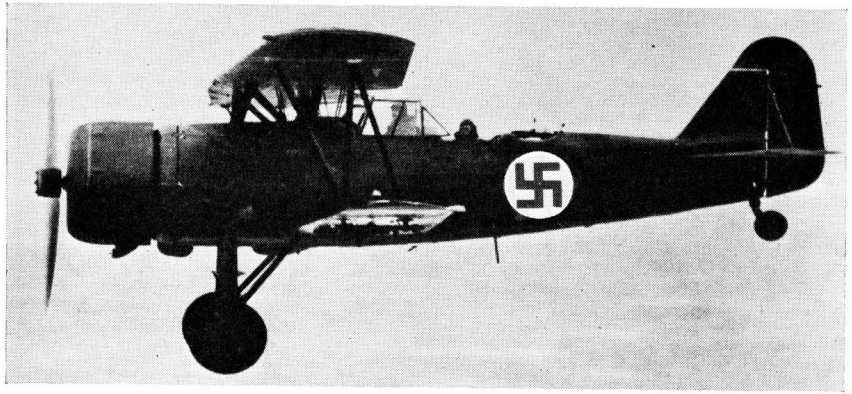
V.L.-FOKKER C.X

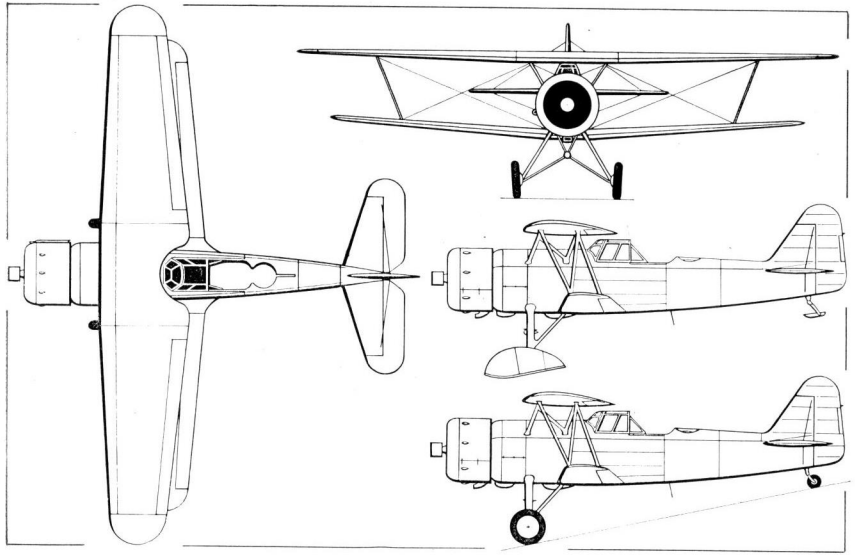
FINLAND

Developed in 1933 by the Dutch N.V.N.V. Fokker as a successor to the C.V, which, in its Mercury-powered C.VE form, had been adopted by the Finnish Air Force, the **C.X** was intended to fulfil reconnaissance, attack and dive-bombing roles and was selected by the Finnish government in 1936 as a successor to the C.VE for tactical reconnaissance and artillery observation tasks. A tandem two-seat single-bay staggered sesquiplane, the C.X employed a typical Fokker structure comprising a welded steel-tube fuselage, the forward portion and upper decking of which were covered by light alloy panels and the remainder by fabric, and wooden wings with plywood and fabric covering. The fuselage structure was of rectangular section faired to an oval, the upper wing, which carried the statically- and aerodynamically-balanced ailerons, comprised two spruce box-spars with plywood webs and ribs, and the lower wing, which was built in two halves and carried landing flaps, employed two solid spruce spars with plywood ribs. The tail and all movable control surfaces were metal-framed and fabric-covered.

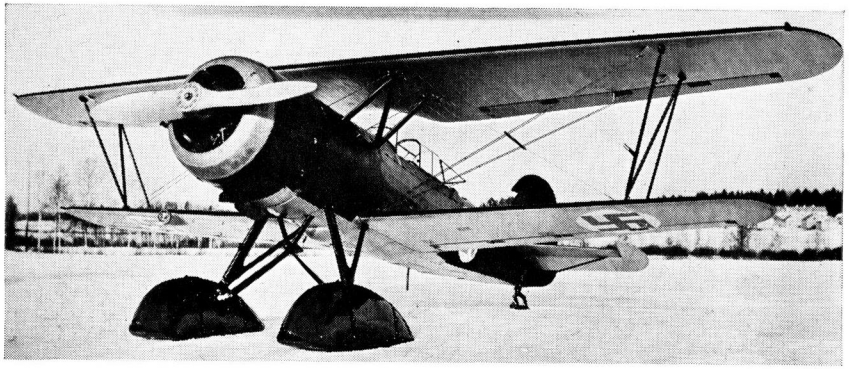
Whereas the Fokker C.X ordered by the Dutch *Luchtvaartafdeling* was powered by the liquid-cooled Rolls-Royce Kestrel V engine, the Finnish government elected to use the medium-supercharged Bristol Pegasus nine-cylinder radial for which the Tammerfors Linne och Jern-Manufaktur A.B. at Tampere

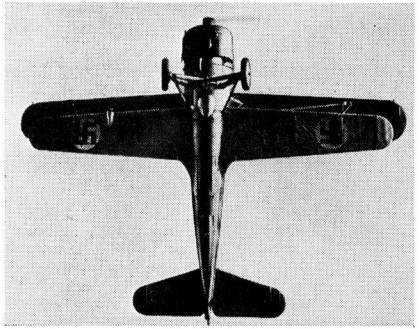
The V.L.-built Fokker C.X served with the Finnish Air Force throughout World War II, being reinstated in production in 1942





had acquired a manufacturing licence in 1935. Four Pegasus-engined C.Xs were delivered by the parent company to Finland, and the Finnish government acquired a licence to build the aircraft at the *Valtion Lentokonetehdas* (V.L.), or State Aircraft Factory, at Tampere. The V.L.-built C.X was powered by the Tammerfors-built Pegasus XII or XXI engine offering 830 h.p. for take-off and 890 h.p. at 6,000 ft., and possessed a superior performance to that of the Kestrel-engined model. The two crew members were seated in tandem, the pilot's cockpit being covered by a glazed sliding canopy, and a glazed panel in the floor provided a measure of downward view. The pilot was provided with one fixed forward-firing 7.62-mm. L-33 machine gun with 500 rounds, and a similar weapon on a flexible mounting was provided the observer whose cockpit was unenclosed and which could house six spare cartridge drums, a camera and a bomb-sight. Racks beneath each wing could lift a pair of 441-lb. bombs or four 220.5-lb bombs plus four 55-lb. bombs or flares.





Production deliveries from the *Valtion Lentokonetehdas* began in 1938, the complete order for 30 aircraft being completed in that year, these being assigned to *LentoRykmentti* (Air Regiment) 1. Four years later, in 1942, the C.X was to be reinstated in production by the V.L., a further batch of five being produced to help make good combat attrition.

OPERATIONAL CAREER

When, on November 30, 1939, the Soviet Union attacked Finland, 29 C.Xs were operational with Finnish Air Force units, one was undergoing servicing at the Air Force Depot and four were undergoing major overhauls at V.L.'s Tampere factory. Of the operational C.Xs, 12 were with T/LeLv 10 at Lapeenranta, these being intended to fulfil the role of dive-bombers; 13 were with T/LeLv 12, a reconnaissance-bomber squadron at Suur-Merijoki and assigned to the *II Armeijakunta* (Army Corps) for operations over the western part of the Karelian Peninsula, and the remaining four were operating alongside seven obsolete C.VEs with T/LeLv 14, a reconnaissance-bomber squadron based at Laikko and assigned to the *III Armeijakunta* (Army Corps) for

operations over eastern Karelia.

Dubbed unofficially the *Franz Kalle* by its Finnish crews (its serial number prefix letters being "FK"), the C.X was extensively employed throughout the "Winter War" which terminated on March 30, 1940, performing close-support and attack missions, directing Finnish artillery fire, and continuously reconnoitring Russian positions and the areas immediately behind the Russian lines. The C.X proved capable of absorbing considerable punishment from groundfire and still regaining its base, and despite its limited defensive armament and apparent vulnerability, attacks by Russian fighters were more often than not frustrated by the adoption of minimum-speed hedge-hopping tactics. Thus attrition proved surprisingly low, and when the "Winter War" terminated, 26 of the 34 C.Xs with which the Finnish Air Force began fighting were still on strength, although nine of these were undergoing repair by the V.L.

When fighting between Finnish and Soviet forces was resumed on June 22, 1941, only one flight of Squadron 12, 3/TLeLv 12, was still operating the C.X, eight aircraft of this type being on strength and these commencing operations from Mikkeli in support of the *VI Armeijakunta* in its advance around Lake Ladoga, subsequently moving up to Nurmoila during the Finnish assault on Petroskoi. The 3/TLeLv 12 continued operating its C.Xs over eastern Karelia until late April 1944 when conversion to Blenheims began. T/LeLv 10 had been redesignated H/LeLv 30 and had converted from C.Xs to Fokker D.XXIs and Hurricanes, and T/LeLv 14 had exchanged its C.Xs for Curtiss Hawk 75As, some of the Fokker biplanes from these units being transferred to T/LeLv 16 as replacements for obsolete Ripon IIFs in one flight, these operating in support of the *VII Armeijakunta* from Tiiksjärvi. This unit was transferred from the 1st to the 2nd *LentoRykmentti* in May 1942, and continued operating C.Xs alongside Lysanders and Gladiators, performing artillery observation, tactical reconnaissance, and even nocturnal intruder missions until the end of the conflict when the unit was based at Hirvas. By this time, only a handful of serviceable C.Xs remained, but the type was destined to soldier on in Finnish service until January 25, 1958 when the last airworthy example of this type (FK-111, the last of the batch of 30 built in 1938 by the V.L.) was destroyed in an accident.

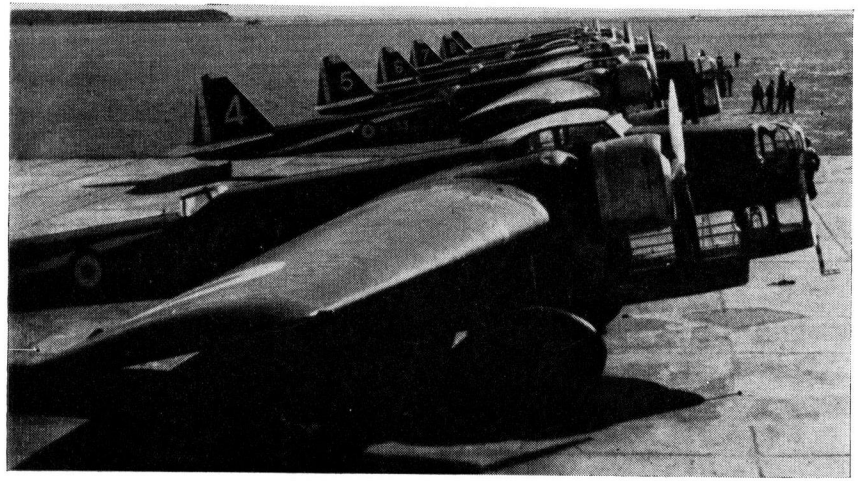
V.L.-FOKKER C.X SPECIFICATION

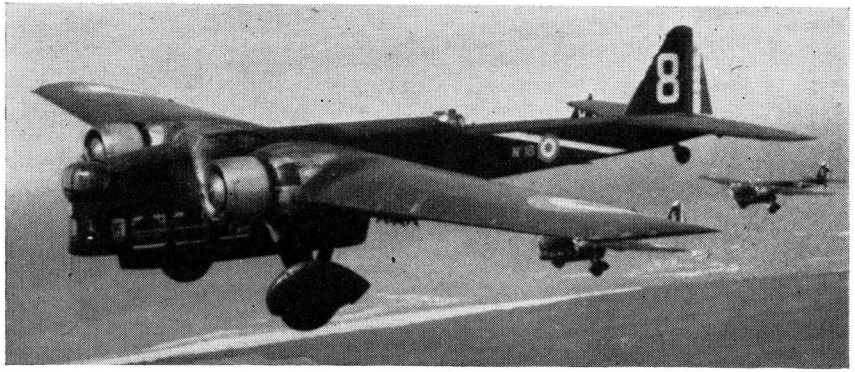
Type: *Two-seat Tactical Reconnaissance and Army Co-operation Aircraft.* **Power Plant:** *One Tammerfors-built Bristol Pegasus XII or XXI nine-cylinder radial air-cooled engine rated at* 830 *h.p. for take-off,* 820 *h.p. at* 3,500 *ft., and* 890 *h.p. at* 6,000 *ft.* **Armament:** *One fixed forward-firing* 7.62-*mm. L*-33 *machine gun with* 500 *rounds, and one* 7.62-*mm. L*-33 *machine gun on flexible mounting in observer's cockpit with six* 100-*round drums, plus two* 441-*lb. or four* 220.5-*lb. bombs and four* 55-*lb. bombs.* **Performance:** *Maximum speed,* 209 *m.p.h. at* 6,000 *ft.; maximum cruising speed (two-thirds power),* 171 *m.p.h. at* 5,740 *ft.; economical cruising speed* (55 % *power),* 162 *m.p.h. at* 3,280 *ft.; range,* 560 *mls. at* 162 *m.p.h.; climb to* 3,280 *ft.,* 2 *min., to* 9,840 *ft.,* 6 *min.; service ceiling,* 26,575 *ft.* **Weights:** *Empty,* 3,417 *lb.; normal loaded,* 5,952 *lb.; maximum,* 6,390 *lb.* **Dimensions:** *Span,* 39 *ft.* 4½ *in.; length,* 30 *ft.* 2¼ *in.; height,* 10 *ft.* 10 *in.; wing area,* 341.215 *sq. ft.*

It has been said that the specifications issued in the late 'twenties and early 'thirties by France's *Service Technique de l'Aéronautique* for so-called *Multiplaces de Combat* enabled French aircraft designers to perpetrate more crimes against aesthetics than could be laid at the doorsteps of the designers of every other aircraft-manufacturing nation combined. This is, of course, an exaggeration, but there was undoubtedly a period in which any connection between aerodynamic cleanliness and the larger French warplanes seemed purely co-incidental, the Gallic designer displaying a quaint proclivity towards ungainly giants with enough glazed panelling in their slab-sided fuselages to satisfy any self-respecting greenhouse, and adorned with immense braced undercarriages and a surfeit of unsightly bird-cage-like turrets. One such aircraft was the Amiot 143M.

The forerunner of the **Amiot 143M**, the Amiot 140, owed its existence to an M4 specification issued in 1928, a four-seat *Multiplace de Combat* suitable for day and night bombing and reconnaissance and long-range escort tasks. The **Amiot 140**, built by the SECM-Amiot plant at Colombes and assembled at Villacoublay, and flown for the first time in April 1931, competed for production orders against the Blériot 137, the Breguet 410 and the SPCA 30. Selected as the winning contender, the Amiot 140 was ordered into production in November 1933, an initial order being placed in that month for 40 aircraft. In the meantime, the SECM-Amiot had been developing the basic design and was offering the **Amiot 142 M4** with 860 h.p. Hispano-Suiza 12Ybrs supercharged liquid-cooled engines and the **Amiot 143 M4** with supercharged Gnôme-Rhône 14K Mistral-Major air-cooled radials, and early in 1934 the initial production order for the Amiot 140 was amended to apply to the more powerful Amiot 143, a further prototype, the **Amiot 143.01** flying in August 1934.

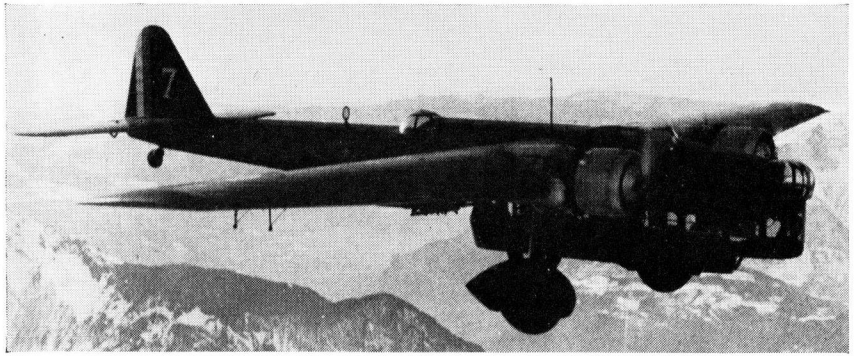
Early production Amiot 143*s of the* 22e *Escadre at Chartres are distinguished by the shorter fuselage nose that characterized the first* 30 *aircraft*





Amiot 143 *bombers of the* 2e *Groupe of the* 22e *Escadre seen during exercises in* 1937. *This Escadre passed its Amiot* 143*s to the* 38e *Escadre during* 1938–39

The Amiot 143.01 had a Gnôme-Rhône 14Kdrs engine in the starboard nacelle and a 14Kgrs engine in the port nacelle, these being rated at 800 h.p. for take-off and 770 h.p. at 14,500 ft., and such was the thickness of the wing that access to the power plants was possible in flight. After the first flight of the prototype the vertical tail surfaces were enlarged, and during September 1934 some reinforcing of the fuselage was carried out. In the following December the engine bearers were lengthened by 9.84 in., and in January 1935 new gun turrets were installed. In February 1935, the Amiot 143.01 was joined by the Hispano-Suiza 12Y-powered **Amiot 142.01**, although, in the event, this aircraft was to be re-engined with Hispano-Suiza 14HA air-cooled radials and, ultimately, with Gnôme-Rhône 14Kirs/jirs engines when it was delivered



Amiot 143 (*No.* 118) *of the* 4e *Escadrille of the* 35e *Escadre based at Bron. This unit converted to the Bre* 691 *and* 693 *late in* 1939

to the *Armée de l'Air* some two-and-a-half years later as the Amiot 143 No. 75.

Bombing and gun-firing trials with the Amiot 143.01 at Cazaux which began in mid-April 1935 coincided with the first flight tests of the production **Amiot 143 No. 1** with Gnôme-Rhône 14Kirs (starboard) and 14Kjrs (port) engines offering 870 h.p. at 10,550 ft. and 900 h.p. at 13,820 ft., and driving three-blade Gnôme-Rhône airscrews, the pitch of which could be adjusted on the ground. The Amiot 143 Ms built against the initial contract (Nos. 1 to 40) had 88 Imp. gal. tanks between the fuselage and engine nacelles on each side, a 123 Imp. gal. tank in each inboard wing leading edge, and two 88 Imp. gal. tanks outboard of the engine nacelles, providing a total fuel capacity of 598 Imp. gal., all tanks being jettisonable. With the forty-first and subsequent aircraft all fuels tanks were transferred to the outer wing sections and the tanks could no longer be jettisoned. Defensive armament comprised a single 0.303-in. Lewis gun in a manually-operated To 23 nose turret with eight 97-cartridge drums, two Lewis guns with 12 97-cartridge drums in a To 14bis dorsal turret (the diameter of this turret being increased from 2 ft. 9½ in. to 3 ft. 5½ in., and its position advanced by 2 ft. 11½ in. with the 31st aircraft), and a pair of Lewis guns on a semi-circular rail in the aft ventral step with 12 97-cartridge drums. With the 31st aircraft, a lengthened nose was also introduced, increasing overall length from 58 ft. 10½ in. to 59 ft. 11 in. With the 41st aircraft the Lewis guns were supplanted by a single 7.5-mm. MAC 1934 machine gun in each position, a supplementary 7.5-mm. gun was mounted on a Type 29 flexible mounting to fire through a hatch in the floor of the forward fuselage,

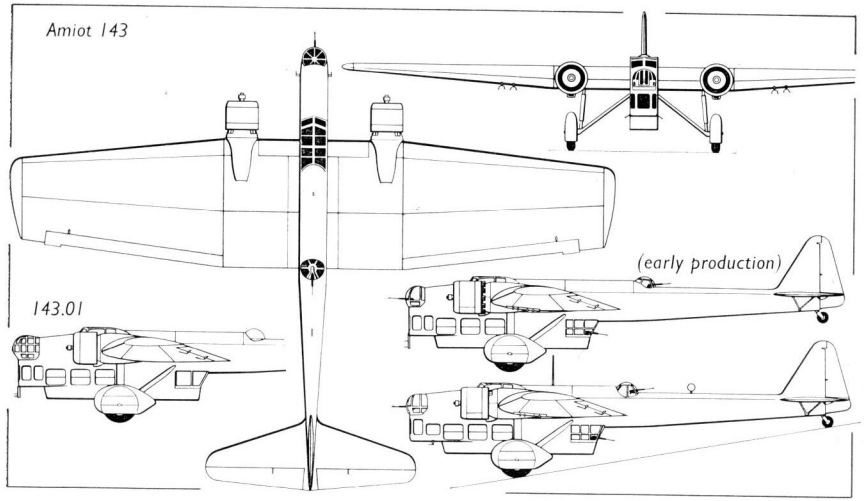
Amiot 143*s of the* 1*er Groupe of the* 22e *Escadre at Chartres*

and the Radio-Industrie ACP 16 long-wave R/T was supplemented by a Bronzavia M535 short-wave R/T set.

Of all-metal construction, the Amiot 143 had an immensely thick wing comprising five sections built up on three duralumin tube girder spars with widely-spaced tube-girder ribs to which an outer skinning of duralumin sheet was riveted, the stub centre-section being built integral with the fuselage. The two inner wing sections carried the engines, and the outer sections (from the 41st aircraft) housed six tanks with a total capacity of 598 Imp. gal., both engines and tanks being accessible in flight for minor adjustments by means of a tunnel between the spars. The rectangular-section fuselage was built up of a number of open-sectioned formers and fore-and-aft stringers covered by flat duralumin sheet, and provided accommodation for five crew members (the decision to employ the Amiot 143 as a night bomber having resulted in the addition of a fifth crew member), the internal bomb-bay being situated to port with a walkway to starboard aft of the navigator-bombardier's and radio-operator's stations in the ventral gondola. The bomb-bay could accommodate four 220-lb. or 441-lb bombs in a single Type S rack, 16 vertically-mounted 110-lb. bombs in two Type D8 racks, or 64 22-lb. bombs in two Type D32 racks.

EXPERIMENTAL VARIANTS

Successive production orders were placed for tue Amiot 143 M5, maintaining the type in production at Colombes until 1937, the 138th and last aircraft of this type making its acceptance flight on March 17th of that year, and during its production life several experimental derivatives and modified versions were tested or projected. One of the first of these



was the **Amiot 144 M5** evolved to meet the requirements of a 1933 *Multiplace de Combat* specification. Retaining the fuselage, the basic wing girder structure, tail surfaces and Gnôme-Rhône 14Kirs/Kjrs Mistral-Major engines of the production Amiot 143 M5, the Amiot 144 embodied some refinement of the aerofoil section, an 8.6 per cent reduction in gross wing area, and introduced wing flaps and retractable main undercarriage members. Flown for the first time on January 18, 1936, the Amiot 144 M5 competed with the Aérienne Bordelaise-80, the Bloch 130, the Breguet 460, the Farman 420, and the Potez 541, but by this time the French Air Staff had begun to appreciate the fact that the entire *Multiplace de Combat* concept was outdated, and development was abandoned.

The **Amiot 145** and **146** were respectively proposed versions of the Amiot 144 with 960 h.p. Hispano-Suiza 14AA and 1,250 h.p. Gnôme-Rhône 18Lars radial engines, neither progressing further than the drawing boards, and the **Amiot 147** was a further Amiot 144 derivative with liquid-cooled Hispano-Suiza 12Ydrs/frs engines of 880 h.p. and twin fins and rudders. This was tested at Villacoublay between October 26 and November 2, 1936, but no further development was undertaken. During 1936, Amiot 143 No. 100 was fitted

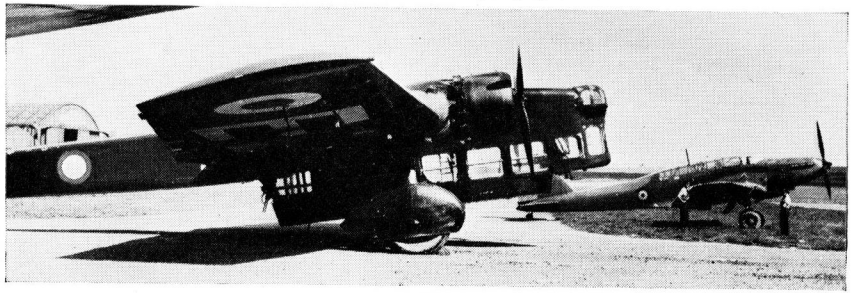
with prototype Gnôme-Rhône 14N engines for trials under tropical conditions in Indo-China, and in 1937, Amiot 143 Nos. 45 and 88 were allocated the civil registrations F-APIQ and F-AQDZ respectively for foreign demonstrations and for communications tasks with the *Ministère de l'Air*. The final derivative of the basic design was the **Amiot 150 BE** (*Bombardement-Exploration*), a scout-torpedo-bomber for the *Aéronavale* with interchangeable wheels and floats. The fuselage, tail assembly and power plants of the Amiot 143 were retained but the wing was redesigned and enlarged by 10 per cent. The sole example was flown at Cherbourg on September 18, 1937, and a redesigned tail assembly with twin fins and rudders was subsequently fitted, but the aircraft was damaged beyond repair as a result of a heavy landing on June 3, 1939.

OPERATIONAL CAREER

The first *Armée de l'Air* unit to convert to the Amiot 143 M was the 3e *Groupe* of the 22e *Escadre* at Chartres in the late summer of 1935. This unit, which was redesignated the 2e *Groupe* on December 1, 1935, was joined by the 1er *Groupe* of the same *Escadre* in January 1936, the next unit to convert to the Amiot 143 being a *Groupe* of the 12e *Demi-Brigade Aérienne* at Mourmelon, this in turn being redesignated the 3e *Groupe* of the 12e *Escadre* in October 1936, and the 14e *Groupe Aérien Autonome* in May 1937. Other *Armée de l'Air* units to receive the Amiot 143 were the 34e *Escadre* at Dugny (1936), the 35e *Escadre* at Bron (1937), the 38e *Escadre* at Metz (the 1er *Groupe* taking over Amiot 143s from the 22e *Escadre* in September 1938, and the 2e *Groupe* following in February-March 1939), and the 2e *Groupe* of the 63e *Escadre* at Marrakesh (spring 1939).

From September 3, 1939, the Amiot 143s of GB I/34, II/34, II/35, I/38 and II/38 flew night reconnaissance and leaflet-dropping sorties over enemy territory, and with the exception of GB II/35 which had converted to the Breguet 691 and 693 and passed its Amiots to GB I/38 and II/38 to bring these *Groupes* up

An Amiot 143 *in company with a Fairey Battle of the Advanced Air Striking Force at a forward base in the spring of* 1940



to full strength, these units were still operating the ageing bomber on May 10, 1940 when the German onslaught began, although GB II/63 at Marrakesh was converting to the Martin167.

From May 10th until June 16th,t he Amiot 143-equipped *Groupements de Bombardement* (the *Escadres de Bombardement* having been disbanded and their *Groupes* gathered in *Groupements* on April 15, 1940) were continuously employed for nocturnal attacks on railway lines, marshalling yards, bridges and roads in the Rhine Valley, Belgium and France. Only one daylight sortie was attempted with the Amiot 143, this taking place on May 14th when a dozen aircraft from GB I/34, II/34, I/38 and II/38 made a desperate attack on the Sedan bridges from an altitude of 2,500 ft. Of the aircraft from GB I/38 and II/38 participating in this action only one returned. Combat attrition on night operations was remarkably low, however, and GB I/34 and II/34, which dropped 338,626 lb. of bombs during the course of 197 sorties, lost only four aircraft which, in view of its low performance, inadequate defensive armament and total lack of armour, provides eloquent testimony to the sturdiness of the Amiot 143.

By the time it was disbanded at Istres on August 24, 1940, GB I/34 had completed conversion to the Amiot 351 and 354, while GB II/34 was operating a mixture of these and Amiot 143s. GB I/38 and II/38, which became components of the Vichy-controlled air arm, continued flying their Amiot 143s until May 1941 when they began conversion to the LeO 451. Subsequently the Amiot 143 was assigned the transport role, and a third *escadrille* was formed on this type as a component of *Groupe de Transport* I/15, the number of Amiot 143s being progressively increased until, as GT III/15, the unit was transferred to Oujda, Morocco, from Istres early in 1942. During the Tunisian campaign the Amiots of GT III/15 provided logistic support, the unit being redesignated GT I/36 on January 1, 1943, and continuing in the transport role until the final defeat of the Axis forces in Tunisia, the last Amiot 143s being grounded in February 1944.

AMIOT 143M SPECIFICATION

Type: *Five-seat Night-bomber and Reconnaissance Aircraft.* **Power Plants:** *Two Gnôme-Rhône* 14*Kirs/jrs Mistral-Major* 14*-cylinder radial air-cooled engines each rated at* 870 *h.p. at* 10,550 *ft. and* 900 *h.p. at* 13,820 *ft.* **Armament:** (*Defensive*) *One* 7.5*-mm. MAC* 1934 *machine gun with* 800 *rounds in manually-operated To* 23 *nose turret, one* 7.5*-mm. MAC* 1934 *machine gun with* 1,200 *rounds in manually-operated To* 14*bis dorsal turret, one* 7.5*-mm. MAC* 1934 *machine gun on flexible mount with* 600 *rounds firing through hatch in floor of forward fuselage, and one aft-firing* 7.5*-mm. MAC* 1934 *machine gun on flexible mount with* 1,200 *rounds in ventral step.* (*Offensive*) *Four* 220*-lb. or* 441*-lb. bombs under outboard wing panels on GPU racks, and one* 1,102*-lb. bomb or four* 220*-lb. or* 441*-lb. bombs, or* 16 110*-lb. or* 64 22*-lb. bombs internally. Alternative external load of* 20 66*-lb. flares.* **Performance:** *Maximum speed,* 193 *m.p.h. at* 13,120 *ft.; cruising speed,* 154 *m.p.h. at* 3,280 *ft.,* 168 *m.p.h. at* 13,120 *ft.; normal range,* 746 *mls.; maximum range,* 1,240 *mls.; time to* 13,120 *ft. at* 18,984 *lb.,* 14 *min.* 20 *sec.; service ceiling,* 25,920 *ft.* **Weights:** *Empty,* 13,448 *lb.; loaded,* 19,568 *lb.; maximum overload,* 21,385 *lb.* **Dimensions:** *Span,* 80 *ft.* 5¾ *in.; length,* 59 *ft.* 11 *in.; height,* 18 *ft.* 7¾ *in.; wing area,* 1,076.39 *sq. ft.*

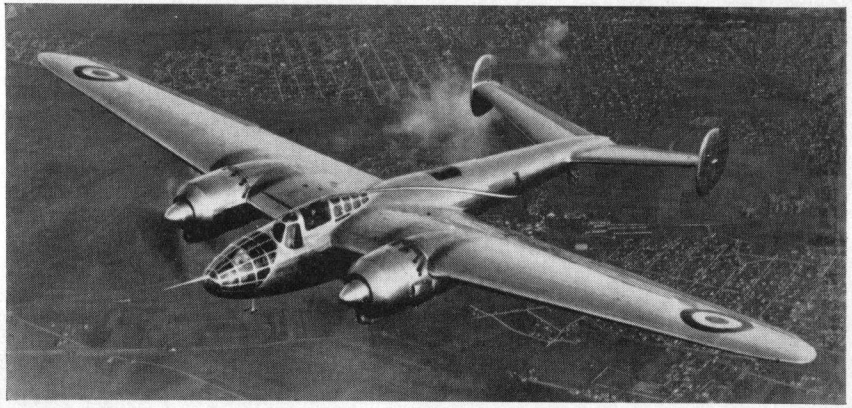
AMIOT 350 SERIES

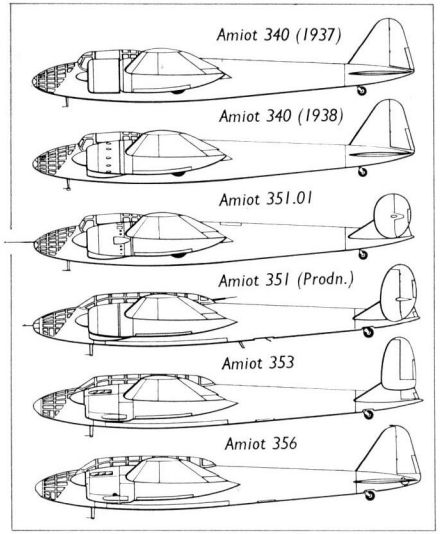
FRANCE

Regarded widely as the very quintessence of aerodynamic cleanliness at the time of its début at the *Salon de l'Aéronautique* held in Paris in 1936, the elegantly-contoured Amiot 341 was undoubtedly an impressive creation, with its efficient circular-section stressed-skin monocoque fuselage to which the shoulder-mounted wing had been carefully faired. Presented as a high-performance long-range postal aircraft, the shapely **Amiot 341**, designed by M. Calvy and his assistants Lambert and Girodin of Avions Amiot (Société d'Emboutissage et de Constructions Mécaniques) at Colombes, was quite obviously intended for more militant tasks than that of delivering mail, and the fact that it featured bomb-bay doors hardly supported the contention that the primary role of the new Amiot product was pacific. Indeed, it came as no surprise when, a year later, on December 6, 1937, this aircraft was flown for the first time at Istres as the **Amiot 340-01** three-seat bomber.

Powered by two Gnôme-Rhône 14N 0/1 14-cylinder radial air-cooled engines rated as 920 h.p. at 12,170 ft., the Amiot 340-01 was flown from Istres to the CEMA (*Centre d'Essais du Matériel Aérien*) at Villacoublay on March 21, 1938 for official trials. During these trials the aircraft was fitted with close-fitting engine cowlings to reduce drag, and the STAé (*Service Technique de l'Aéronautique*) informed Avions Amiot of the various modifi-

After conversion from the Amiot 340-01 *to the Amiot* 351-01 (*below*), *the prototype retained Général Vuillemin's red "cocotte" emblem*

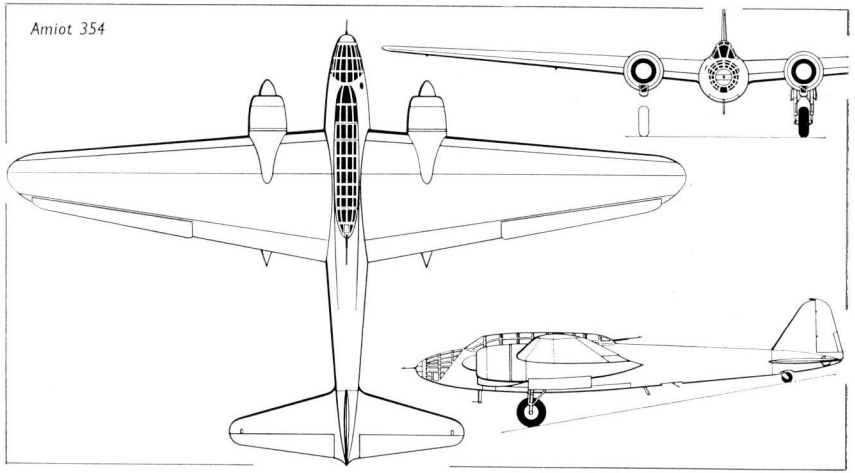




cations that it considered necessary, including provision of accommodation for a fourth crew member, but before the Amiot 340-01 could be flown back to Istres for these changes to be made, the prototype had a part to play in the game of bluff and counter-bluff that was being conducted between France and Germany in that last year of uneasy peace in Europe. The French Chief of Air Staff, *Général* Vuillemin, had been invited to visit Germany, and the sole example of the Amiot 340, with all indications of its prototype status deleted and sporting the red *cocotte* emblem of Vuillemin, was selected to fly the Chief of Air Staff to Berlin on August 16, 1938. The Amiot 340 flew from Villacoublay to Staaken airfield at the not inconsiderable average speed of 273 m.p.h. at an altitude of 13,120 ft., returning to Villacoublay on August 21st. It is not known if the visit persuaded the Germans that the advanced Amiot bomber was already serving with the *Armée de l'Air*; at least the Germans succeeded in convincing *Général* Vuillemin that their experimental He 100 fighter was in mass production for the *Luftwaffe*!

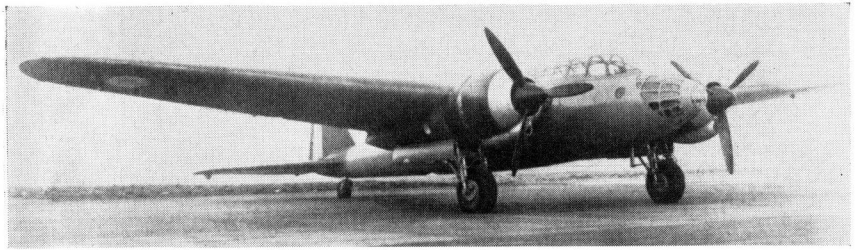
In November 1938, the Amiot 340-01 was re-engined at Istres with two Gnôme-Rhône 14N 20/21 engines rated at 1,020 h.p., provision was made for an additional crew member with a single 7.5-mm. MAC 1934 machine gun on a flexible mount firing through a ventral hatch aft of the bomb-bay, and redesigned tail surfaces were introduced, the single fin-and-rudder assembly being supplanted by oval endplate fins and rudders, marked dihedral being applied to the tailplane. In this form and redesignated **Amiot 351-01**, the prototype resumed flight trials on January 21, 1939 at Istres, and was flown to the CEMA at Villacoublay in the following month.

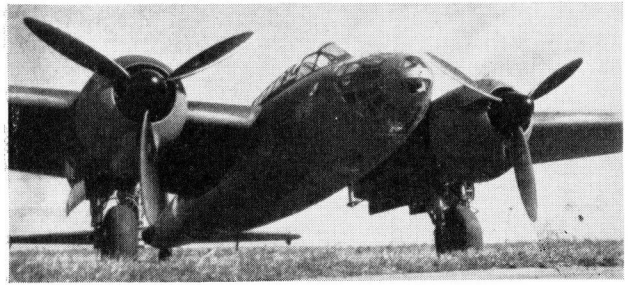
In 1938, Calvy's team had instituted some redesign of the basic Amiot 340 to meet the STAé demands resulting from intial trials with the Amiot 340-01, this having produced the Amiot 350 series comprising one standard airframe capable of accepting a variety of different power plants. Thus, the **Amiot 350** was intended to be powered by two Hispano-Suiza 12Y 28/29 12-cylinder liquid-cooled engines offering 920 h.p. at 10,970 ft., the **Amiot 351** was to have Gnôme-Rhône 14N 38/39 14-cylinder air-cooled radials rated at 950 h.p. at 12,150 ft., the **Amiot 352** was a version with Hispano-Suiza 12Y 50/51 engines of 1,100 h.p. at 10,695 ft., and the **Amiot 353** had Rolls-Royce Merlin IIIs of 1,030 h.p. at



16,250 ft. The introduction of Gnôme-Rhône 14N 48/49 engines offering 1,070 h.p., and reversion to a single fin-and-rudder tail assembly similar to that of the original Amiot 340-01 resulted in the **Amiot 354**, and with Merlin X engines of 1,130 h.p. this variant became the **Amiot 356**.

Essentially the Amiot 350 production series aircraft differed from the Amiot 351-01 in having a wing of reduced span (from 75 ft. 5½ in. to 74 ft. 10¾ in.) and area (from 726.56 to 721.18 sq. ft.), an increase in overall length (from 45 ft. 11¼ in. to 47 ft. 6¾ in.), and, in the case of those variants retaining the twin fin-and-rudder tail assembly, substantially enlarged endplate vertical surfaces. Furthermore, the raised cockpit canopy, which, on the Amiot 351-01, was offset to port, was both widened and lengthened, and repositioned centrally on the fuselage. The Hispano-Suiza-powered Amiot 350 was not proceeded with, and the first production aircraft to fly was the **Amiot 351 No. 1** which was completed in the summer of 1939 and, owing to the extensive differences between this and the Amiot 351-01, was sent to Orléans-Bricy for CEMA trials, flying there for the first time on November 3, 1939. A few days later it was joined at Orléans-Bricy by the second production aircraft, the **Amiot 354 No. 2** (a common sequence having been adopted for all Amiot 350 Series production numbers as the airframes were identical apart from the tail surfaces which were interchangeable), this being returned to Avions





(Above and left) Amiot 354 B4 No. 10, one of the relatively small number of bombers of this type completed at Le Bourget prior to the Armistice

Amiot for modifications on December 19, 1939, resuming CEMA tests on January 10, 1940.

Initial production orders for the Amiot 350 Series placed in 1938 called for 30 Amiot 351s, 60 Amiot 353s and 40 Amiot 354s, but prior to the start of World War II supplementary orders had been placed for 30 Amiot 351s, 100 Amiot 353s and 35 Amiot 356s. These orders were to be augmented soon after the conflict began by contracts for 560 Amiot 352s, and a further 30 Amiot 351s and five Amiot 356s to bring total contracts to 890 aircraft. Production of the fuselages was undertaken by the Amiot plant at Colombes, the wings were manufactured by the Chantiers Aéronautiques de Normandie at Cherbourg, and the tail assemblies were produced at SNCAC's Billancourt factory, final assembly taking place at Le Bourget.

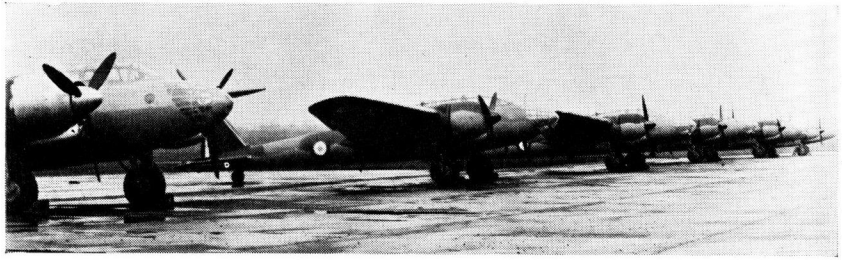
All Amiot 350 Series aircraft were basically similar, their structure comprising a circular-section stressed-skin monocoque fuselage built in three sections, and a wing built up on a main spar and two auxiliary spars with stressed-skin covering and built in two halves which attached

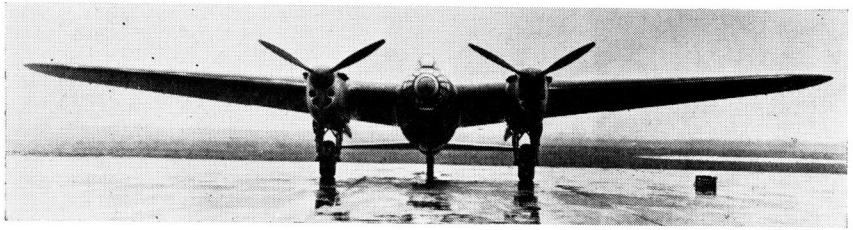
directly to the fuselage mainframes. The electrically-operated undercarriage was fully retractable, each main member comprising two oleo legs and two inclined articulated struts which raised the wheel backwards into the tail of the engine nacelle. The crew comprised a navigator-bombardier in the extreme nose with a 7.5-mm. machine gun on an SAMM-AB20 (Type 161) flexible mounting, a pilot seated above the forward portion of the bomb-bay, a dorsal gunner with a 20-mm. Hispano-Suiza 404 cannon on a SAMM-AB34 power-operated flexible mount above the aft end of the bomb-bay, and a radio-operator with a 7.5-mm. machine gun firing through a ventral hatch. All fuel was housed in the wing inboard of the engine nacelles, six tanks accommodating a total of 616 Imp. gal. of fuel.

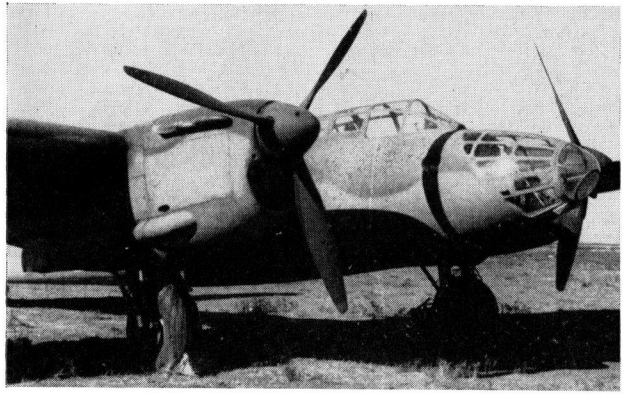
Prior to November 1939, it had been intended to complete a proportion of the Amiot 350 Series aircraft on order as four-seater reconnaissance aircraft, but this order was rescinded and all aircraft were delivered as bombers. Only a few Amiot 351 B4 and 354 B4 had been completed by the beginning of 1940, despite the urgency that was attached to the service introduction of the bomber, five having been taken on charge by the *Armée de l'Air*. A further 12 had been taken on charge by March 1, 1940, although the *Armée de l'Air* had anticipated delivery of 80 aircraft by this date. Of those aircraft that had been delivered only six had the 20-mm. dorsal cannon installed, inadequate supplies having necessitated the installation of a 7.5-mm. machine gun in lieu of the heavier weapon in the others (aircraft Nos. 7 to 46 inclusive were to be delivered without the cannon). Owing to the inadequacy of the single small-calibre weapon, a trio of 7.5-mm. Darne machine guns on a single flexible mount was considered as dorsal armament, and firing trials with this installation were conducted with one machine at Cazaux in the spring of 1940, but as supplies of the Hispano-Suiza cannon were expected to improve, the triple-gun mounting was not adopted as standard.

Production continued at an extremely slow tempo, a total of 21 aircraft having been taken on charge by April 1, 1940, as compared with

Six Amiot 354s awaiting acceptance by the Armée de l'Air at Le Bourget in the late spring of 1940. GB I/21 and II/21 were the first units to convert to this type







(Above and left) The Amiot 356 No. 01 with Merlin X engines. This aircraft eventually became F-BAGP, entering service with Air France.

the 285 aircraft planned. By May 1st the *Armée de l'Air* had accepted 37 aircraft, and by the end of the month 17 Amiot 351 B4s and 40 Amiot 354 B4s had been accepted, and conversion of some *Groupes de Bombardement* to the new aircraft had begun.

EXPERIMENTAL VARIANTS

While production tempo had been slowly building up several further Amiot 350 Series aircraft had been under development, including the **Amiot 355** prototype, this being the 12th production airframe fitted with Gnôme-Rhône 14R 2/3 radials rated at 1,200 h.p., these being similar to the GR 14N of the Amiot 351 and 354 but fitted with two-speed superchargers. This aircraft was being readied for flight testing at Le Bourget early in June, and with the approach of the *Wehrmacht* it was hurriedly flown to Pau, eventually being placed in storage at the *Base de Stockage* at Clermont-Ferrand-Aulnat.

Prior to the début of the Amiot 355 another

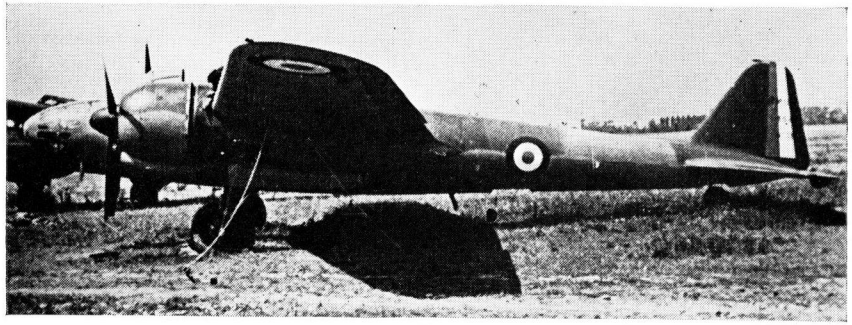
prototype, the **Amiot 356-01**, had commenced its flight test programme. Apart from having the more powerful Merlin X engines and a single fin-and-rudder tail assembly, the Amiot 356 was essentially similar to the 353, and the prototype was evacuated from Villacoublay where it was undergoing CEMA tests and flown to Toulouse. Yet a further experimental Amiot 350 Series aircraft was the **Amiot 357** high-altitude bomber with pressurized accommodation for the crew and a pair of turbo-supercharged Hispano-Suiza 12Z(HS-89ter) 12-cylinder liquid-cooled engines. Intended to operate at altitudes of the order of 37,000–39,000 ft., the Amiot 357 was nearing completion at Le Bourget on June 14, 1940 when the Amiot plant was occupied by German forces.

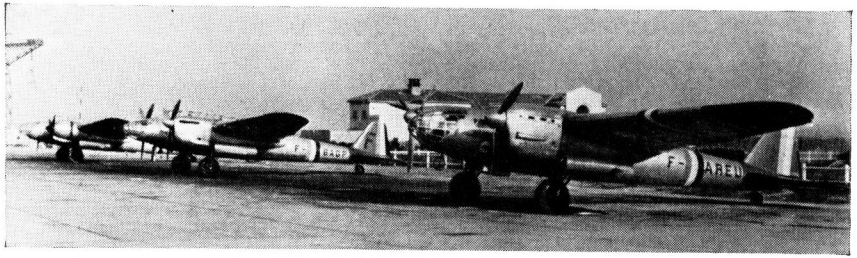
One other aircraft closely related to the Amiot 350 Series was the **Amiot 370** which, in fact, preceded the original Amiot 340-01 into the air, flying for the first time at Istres on July 25, 1937. Although it was to be widely stated that the Amiot 370 was a bomber, it was actually a parallel development to the Amiot 340 and intended solely for record-breaking purposes. Structurally similar to the prototype bomber, the Amiot 370-01 was powered by two 860 h.p. Hispano-Suiza 12Yjrs/krs 12-cylinder liquid-cooled engines, and surpassed even the Amiot 340 in purity of line as no raised cockpit canopy broke the upper line of the fuselage, the two crew members being housed in the nose entirely within the fuselage contours. Registered F-AREU, the Amiot 370-01 established a number of distance records in 1938

OPERATIONAL CAREER

By May 10, 1940, the *Groupes de Bombardement* I/21 and II/21 were in process of conversion from the Bloch 210 and possessed between them half a dozen Amiot 351s and 354s, the first operational flights having been undertaken by GB II/21 on April 28th. On April 7th, GB I/34 and II/34 had each taken

One of the relatively few Amiot 454s that reached the Groupe de Bombardement II/21 which undertook operational sorties with the bomber on April 28, 1940



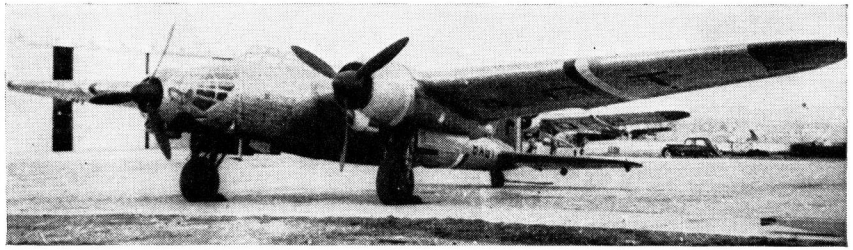


(Left to right) The Amiot 354 *No.* 68 *(F-BAGQ), the Amiot* 356-01 *(F-BAGP), and the Amiot* 370-01 *(F-AREU) seen in Air France service at Marignane in* 1942

delivery of one Amiot 354, these units, together with GB I/21 and II/21, forming *Groupement* 9. Despite their transitional state, these units were hurried into battle, performing operational sorties and simultaneously converting to the Amiot 351s and 354s as sufficient aircraft became available. By June 20th, the *Armée de l'Air* had officially taken 61 Amiot 350 Series aircraft on charge, although, in fact, this was not the final figure as a number of additional machines were taken over by the *Groupes* without the formality of official acceptance procedure during the days immediately preceding the arrival of German forces at Le Bourget on June 14th, and at this time seven aircraft (Nos. 87 to 93) were awaiting collection. At least one of these (No. 87) was flown away before the *Wehrmacht's* arrival, landing at Oran on June 21st.

Both *Groupes* of the 21e *Escadre* completed conversion to the Amiot 351 and 354 before the termination of hostilities, but retained Bloch 210s for night bombing sorties as insufficient Amiots were available for total re-equipment. GB I/34 retained Amiot 143s for the same reason, and although all GB II/34 crews had completed conversion by June 20th, this unit flew no operational sorties with the new bombers as the few machines available were either destroyed on the ground or handed to other units. Between May 10th and June 17th Amiot 351s and 354s undertook a number of daylight bombing sorties and nocturnal reconnaissance missions, 13 of these aircraft being lost by *Groupement* 9. In fact, only three of these were lost in action, one of these by the 21e *Escadre* and two by the 34e *Escadre*, the remainder being lost in training accidents or destroyed on the ground by bombing.

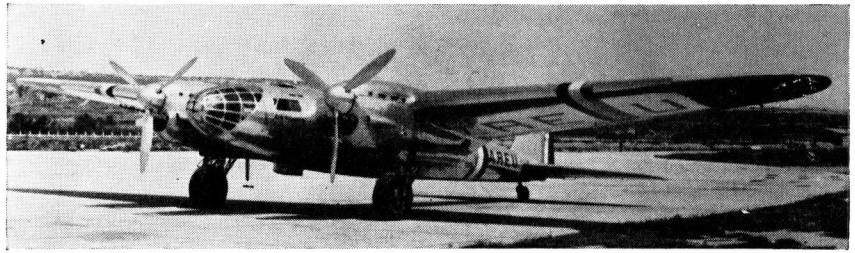
Following the disbandment of GB I/21, II/21, I/34 and II/34, the surviving Amiot 350 Series aircraft were placed in storage in the various *Bases de Stockage*, but several were subsequently overhauled for operation by Air France on high-speed services between Vichy France and overseas territories, fuel tankage being increased to a total of 1,160 Imp. gal. by the addition of auxiliary tanks in the bomb-bay. After the removal of military equipment and the installation of the long-range tanks, the Amiot 356-01 was registered F-BAGP and made its first commercial flight

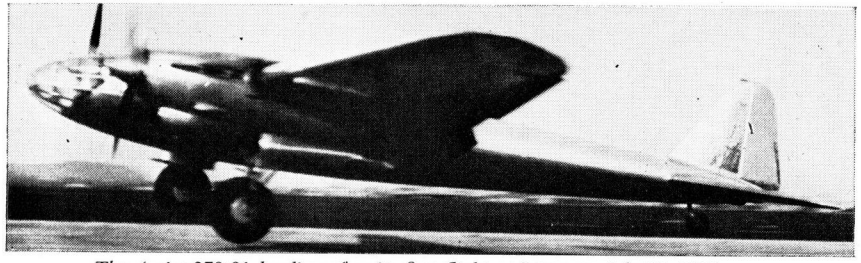


Amiot 354 *No.* 79 *(F-BAGT) after adaptation for use by Air France over routes from Vichy France to France's overseas territories*

from Marignane to Algiers, Dakar, Casablanca, and back to Marignane in October 1941. It was joined in Air France service by Amiot 354 No. 68 registered F-BAGQ, and together with the Amiot 370 F-AREU these aircraft flew frequently between Marignane and the African territories until November 1942. Amiot 354 No. 79 was also adapted for use by Air France as F-BAGT, together with an Amiot 351 registered F-BAGS, but for various reasons these aircraft were not placed in service. Amiot 354 No. 11 was converted as a VIP transport for Admiral Auphan, but this aircraft was destroyed in October 1942 while landing at Vichy, and Amiot 354 No. 10 was transported to Marignane on October 15, 1942 in order to be converted in the SNCASE plant to Amiot 356 standards by the in-

The Amiot 370-01 *(F-AREU) which was employed by Air France on postal services between Marseilles and Djibouti. The turbo-compressors were removed*





The Amiot 370-01 *landing after its first flight at Istres on July* 25, 1937

stallation of two Merlin X engines, but the total German occupation of November 11th frustrated this plan.

When German forces entered France's Unoccupied Zone they found one Amiot 354, one Amiot 356 and two Amiot 351s. One of the Amiot 351s was promptly adopted for transport duties on behalf of the Headquarters Staff of *Luftflotte* 3, and the other, together with the Amiot 356, eventually joined the strength of 1. Staffel of I/KG.200. In 1946, the surviving Amiot 354, which had been abandoned at Istres when the German forces withdrew, was fitted with two Pratt & Whitney R-1830 Twin Wasp engines and, redesignated **Amiot 364**, entered service with the *Groupe de Liaisons Aériennes Ministérielles* which operated this aircraft from Villacoublay.

AMIOT 354 B4 SPECIFICATION

Type: *Four-seat Medium-range Bomber.* **Power Plants:** *Two Gnôme-Rhône* 14*N* 48/49 14-*cylinder radial air-cooled engines each rated at* 1,060 *h.p. for take-off and* 990 *h.p. at* 9,510 *ft.* **Armament:** (*Defensive*) *One Hispano-Suiza HS* 404 *cannon of* 20-*mm. calibre on power-operated flexible SAMM-AB*34 *in dorsal position with* 120 *rounds, one* 7.5-*mm. MAC* 1934 *machine gun on SAMM-AB*20 *flexible mounting in nose with* 500 *rounds, and one* 7.5-*mm. MAC* 1934 *gun on flexible mount firing from ventral position with* 800 *rounds.* (*Offensive*) *Two* 1,102-*lb. bombs or six* 441-*lb. bombs internally.* **Performance:** (*The following figures apply specifically to the Amiot* 354 *but are generally applicable to the Amiot* 351) *Maximum speed,* 255 *m.p.h. at sea level,* 298 *m.p.h. at* 13,120 *ft.; maximum cruising speed,* 248 *m.p.h. at* 13,120 *ft.; long-range cruising speed,* 217 *m.p.h.; range with* 1,764-*lb. bomb load,* 1,553 *mls. at* 248 *m.p.h.,* 2,175 *mls. at* 217 *m.p.h.; time to* 13,120 *ft.,* 8.7 *min.; ceiling,* 32,810 *ft.* **Weights:** *Empty,* 10,417 *lb.; maximum loaded,* 24,912 *lb.* **Dimensions:** *Span,* 74 *ft.* 10¾ *in.; length,* 47 *ft.* 6¾ *in.; height,* 13 *ft.* 4½ *in.; wing area,* 721.18 *sq. ft.*

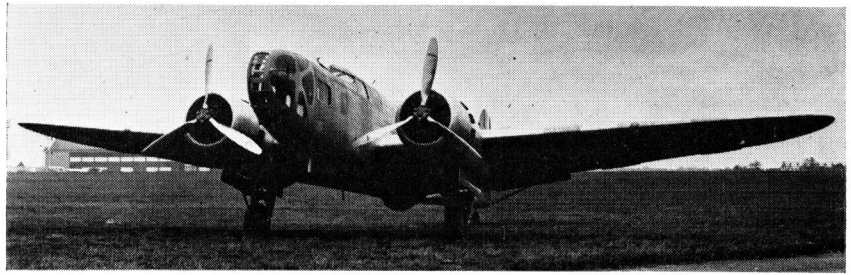
BLOCH 131 FRANCE

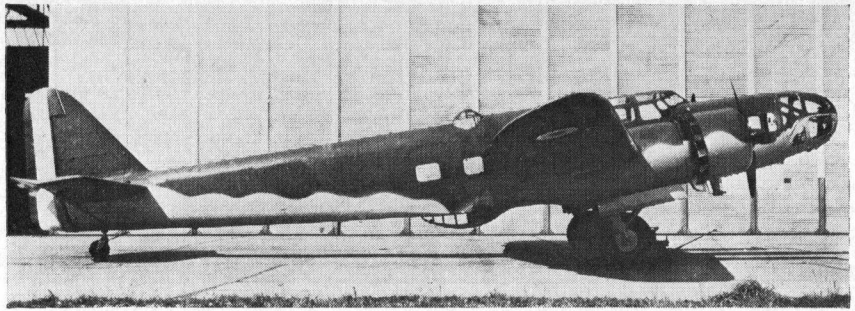
During the late 'twenties and early 'thirties it seemed that French aircraft manufacturers were endeavouring to vie with each other in producing aesthetically unattractive warplanes, French designers revealing an astonishing propensity towards angularly ugly monstrosities; ponderous combat machines with few concessions to aerodynamic cleanliness. The appearance of the **Bloch 131** in the summer of 1936 was, therefore, all the more noteworthy, for this low-wing all-metal reconnaissance-bomber, with its retractable undercarriage and flush-riveted skin, revealed a radical change in French design thinking. If not exquisitely contoured, its lines and performance were fully comparable with those of the most modern bombers entering production in Germany, the Soviet Union, and on the other side of the Atlantic, although events were to prove that it lacked the development potential necessary to keep it in the forefront in the period of accelerated combat aircraft evolution into which it was born.

In August 1933, the *Service Technique de l'Aéronautique* had prepared a specification for a new *Multiplace de Combat*; a multi-seat, multi-purpose aircraft capable of fulfilling roles ranging from bombing and reconnaissance to long-range escort duties. In view of developments in combat aircraft taking place abroad, any aircraft meeting this specification had built-in obsolescence. Nevertheless, eight manufacturers competed for production contracts, and prototypes of the Amiot 144, the Aérienne Bordelaise 80, the Bloch 130, the Breguet 460, the Farman 420, and the Potez 541 were built, while two other contenders, the Couzinet 190 and the Dewoitine 420, progressed no further than the drawing boards.

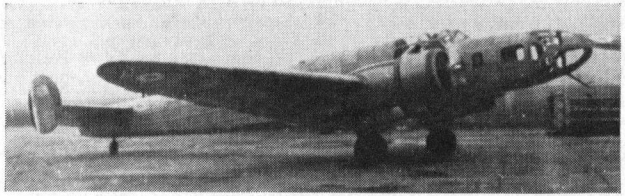
Marcel Bloch's offering, the **Bloch 130M**, flew for the first time early in June 1934 at Villacoublay, the fixed undercarriage subsequently being replaced by an undercarriage of retractable type. After some refinement of the aircraft, an order was placed in October 1935 for 40 Bloch 130Ms. However, both the

An early production Bloch 131 *R*4 *reconnaissance aircraft seen while undergoing CEMA trials during the early summer of* 1938





(*Above*) *Bloch* 131 *RB4 No.* 100 *seen after completion at the SNCASO's Bordeaux-Mérignac plant in spring of* 1939, *and* (*below*) *the sole example of the Bloch* 133.



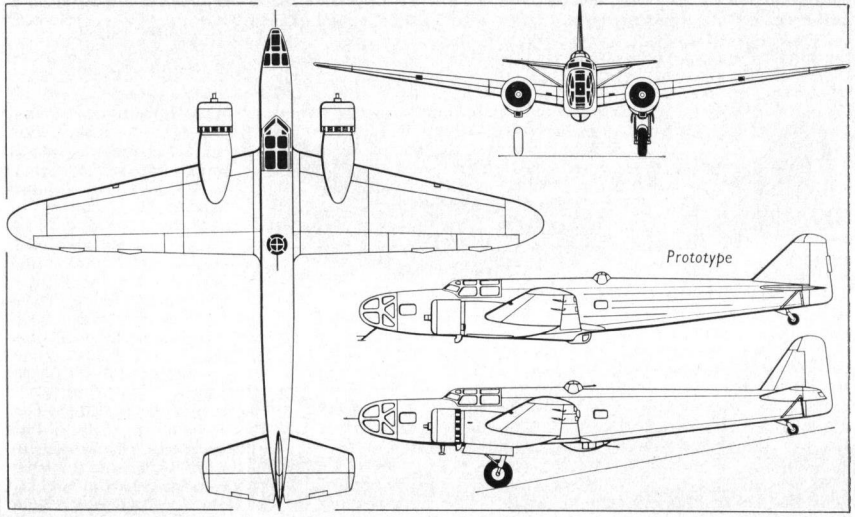
Air Staff and Avions Marcel Bloch had, by this time, begun to appreciate the fact that the *Multiplace de Combat* concept was no longer valid, and Bloch had already initiated the design of an appreciably more advanced and rather more specialised aircraft, the **Bloch 131 RB4**, a four-seat bomber-reconnaissance aircraft that had nothing in common with the Bloch 130M. The order for the earlier aircraft was, accordingly, shelved pending the outcome of prototype trials with the new design.

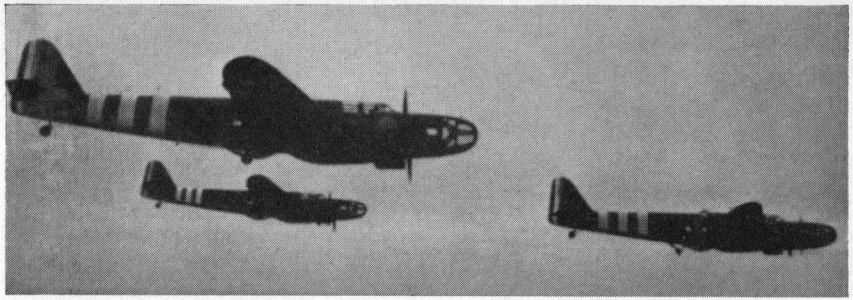
The Bloch 131 No. 1 was built at Courbevoie and assembled at Villacoublay where the first flight took place on August 12, 1936. A second prototype, the **Bloch 131 RB5** No. 2, was exhibited at the *Salon de l'Aéronautique* held in Paris in November 1936, this differing from the initial machine in having accommodation for an additional crew member. The dorsal turret had been moved further aft, a ventral turret had been introduced, the chord of the fin had been increased, and the bracing struts had been removed for the tailplane. This prototype was flown for the first time on May 5, 1937, and in the meantime, the first prototype had been flown from Villacoublay to Marignane for CEMA (*Centre d'Essais du*

Matériel Aérien) trials on December 6, 1936. Further CEMA trials had been conducted at Villacoublay in April, and an order for 40 Bloch 131s had officially supplanted the previous order for a similar quantity of Bloch 130Ms.

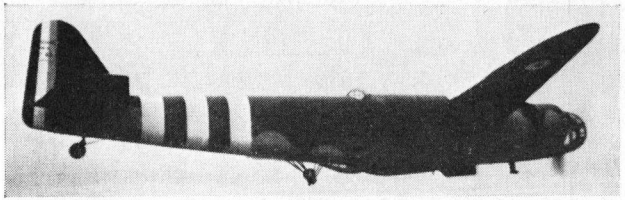
During early manufacturer's trials with the first prototype some tail flutter had manifested itself, and on the assumption that this was caused by lack of torsional rigidity, the rear fuselage was reinforced by externally riveted stringers. It was eventually ascertained, however, that the flutter could be eliminated by reducing tailplane span and introducing some dihedral. Both prototypes were powered by Gnôme-Rhône 14K Mistral-Major 14-cylinder air-cooled radial engines rated at 870 h.p. at 10,550 ft. and 900 h.p. at 13,820 ft., but in the summer of 1937, by which time Avions Marcel Bloch had been absorbed by the Société Nationale de Constructions Aéronautiques du Sud-Ouest (SNCASO), these power plants were replaced by the Gnôme-Rhône 14N 10/11 engines which, of similar output, offered improved cylinder cooling and a carburettor incorporating an automatic altitude control and other improvements.

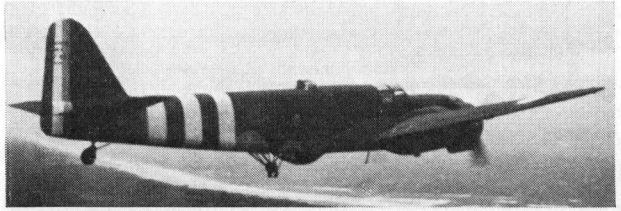
The first prototype was experimentally fitted with a 20-mm. cannon on a flexible mount in the extreme nose, the mount permitting exten-





The Vichy-controlled Armée de l'Air employed a number of Bloch 131s for target towing during 1941–42, the example illustrated by the two photographs below left being the Bloch 131 RB4 No. 43. The black-and-white striping should not be confused with Allied 'invasion' striping





sive movement in the vertical plane but only a few degrees of traverse. However, this weapon had been abandoned in favour of a 7.5-mm. MAC 1934 machine gun when, in September 1937, the second prototype underwent firing trials at Cazaux. The first production aircraft, the Bloch 131 No. 3, had commenced flight trials almost simultaneously with the second prototype, and this had a semi-retractable ventral gun position at the extremity of the step in the fuselage underside

contour. During the second half of June 1937, this aircraft performed speed trials at the CEMA with the ventral gun position fully extended, but the complexity and weight of this type of defensive position was not fully compensated for by the reduction in drag resulting from the retraction of the turret and, in consequence, the ventral step was eliminated from subsequent production aircraft and the retractable position replaced by a shallow fixed semi-glazed position, this gondola containing a single 7.5-mm. MAC 1934 machine gun on a flexible Type 29 mounting.

The first production machine from the SNCASO's Châteauroux-Déols plant was flown in May 1938, the initial batch of 14 aircraft (Nos. 3 to 15) being **Bloch 131 R4** four-seaters equipped solely for reconnaissance tasks, these being followed by five (Nos. 16 to 20) **Bloch 131 Ins** dual-control instructional aircraft. The second prototype was also modified to Bloch 131 Ins standards and delivered to the *Armée de l'Air*. The nineteenth production machine (No. 21) was the first Bloch 131 RB4 intended for the dual bombing-reconnaissance role, and approximately 100 aircraft of this model were subsequently manufactured (Bloch 131 RB4 No. 122 being delivered to GR I/36 in October 1939) by SNCASO's Châteauroux-Déols and Bordeaux-Mérignac plants.

Externally, the Bloch 131 RB4 displayed no differences from the R4, but the mainwheels were enlarged, and the internal bomb-bay could be fitted with various types of Alkan racks for bombs ranging from 22 to 441 lb. in weight. The navigator-bombardier in the extreme nose, who also operated the Labrely F30 or F50 camera, was provided with a single MAC 1934 gun with limited vertical and horizontal travel, and similar weapons were mounted in the manually-operated swivelling dorsal turret and in the ventral gondola, that in the latter position being fired by the radio-operator who was provided with SFR 203 R/T. All aircraft were equipped with a Jeager-Smith autopilot, and power was provided by two inwardly-rotating Gnôme-Rhône 14N 10/11 engines driving 9 ft. 11½ in. Ratier 1453/1454 three-blade airscrews. The 378 Imp. gal of fuel was housed by six tanks within the wing centre section torsion box.

Construction of the Bloch 131 was all-metal, the fuselage being of rectangular cross section built up on a series of omega-shaped bulkheads and four longerons covered by light alloy panelling, and the wings being similarly-covered, four-piece two-spar structures with detachable leading edges and tips. The split flaps were pneumatically operated, and the main undercarriage members, which lifted forward into engine nacelle wells, were hydraulically operated. Unlike that of the prototypes, the wing of the production aircraft was set at a 3° 40′ angle of attack at the request of the Air Staff which had demanded improved short-field performance at the expense of maximum and cruising speeds.

Only one experimental development of the basic Bloch 131 was tested, this being the **Bloch 133** which, flown on October 1, 1937, retained the Bloch 131 fuselage with the standard tail assembly replaced by oval endplate fins and rudders, and Hispano-Suiza 14AA radials in place of the Gnôme-Rhônes.

OPERATIONAL CAREER

Deliveries of the Bloch 131 to the *Armée de l'Air* began during the summer of 1938, and during the course of September the 22e *Escadre* at Chartres began conversion, followed in January 1939 by the 1er *Groupe* of the 55e *Escadre* at Bron. During the following spring the 14e *Groupe Aérien Autonome* at Mourmelon and the 1er *Groupe* of the 35e *Escadre* also converted to the Bloch 131, and by September 3, 1939, the *Armée de l'Air's* Bloch 131-equipped units comprised the 14e GAA, GR

I/22, II/22, I/35, I/55 and II/55 in France and I/61 in North Africa.

From the commencement of hostilities, the Bloch 131s of the 14e GAA and GR II/22 and II/55 flew day reconnaissance sorties over the Saarland and Pfalz areas, and night missions over the Danube Valley, but it was soon obvious that the performance of this type rendered it obsolete for daylight missions and it was quickly restricted to nocturnal sorties, and re-equipment with the Potez 63.11 was hastened. As the *Groupes de Reconnaissance* converted from the Bloch 131, some of their aircraft were passed to GR I/36 and II/36 which operated these alongside a mixture of Potez 540s and 637s pending their own conversion to the Potez 63.11 However, by May 10, 1940, all *Groupes*, with the sole exception of GR I/61 which was still operating the Bloch 131 in North Africa, had re-equipped, and the type had disappeared from the *Armée de l'Air's* first-line inventory in Europe.

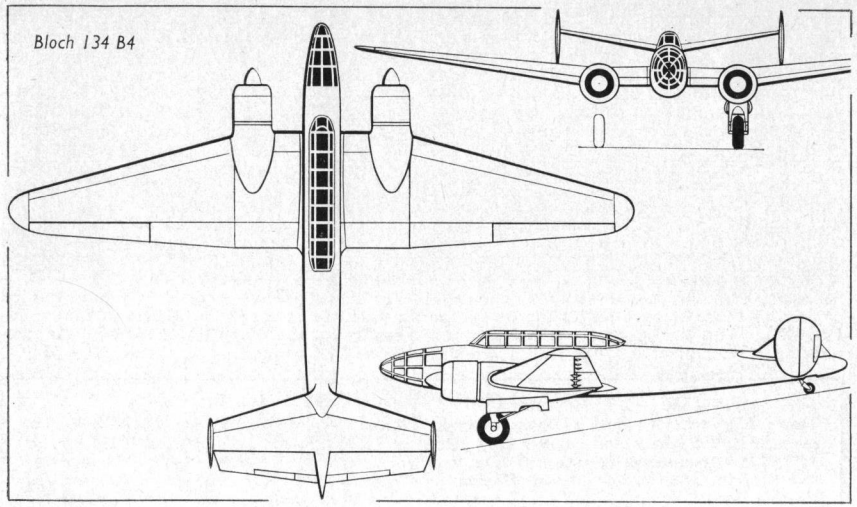
After the Armistice a score or so of Bloch 131s existed in the unoccupied zone, and a number of these were converted for use by the Vichy-controlled *Armée de l'Air* for use as target-tugs, the ventral gondola being modified to house winch and cable drum.

BLOCH 131 RB4 SPECIFICATION

Type: *Four-seat Bomber-Reconnaissance Aircraft.* **Power Plants:** *Two Gnôme-Rhône* 14*N* 10/11 14-*cylinder radial air-cooled engines each rated at* 950 *h.p. at* 12,170 *ft.* **Armament:** (*Defensive*) *One* 7.5 *mm. MAC* 1934 (*on flexible mount*) *in extreme nose with* 500 *rounds, one* 7.5-*mm. MAC* 1934 *gun in dorsal turret with* 1,500 *rounds, and one* 7.5-*mm. MAC* 1934 *gun* (*on flexible mount*) *in ventral gondola with* 1,500 *rounds.* (*Offensive*) *Four* 441-*lb., six* 220-*lb., eight* 110-*lb., or* 64 22-*lb. bombs internally.* **Performance:** *Maximum speed,* 188 *m.p.h. at sea level,* 217 *m.p.h. at* 12,300 *ft.; economical cruising speed,* 140 *m.p.h. at sea level,* 168 *m.p.h. at* 12,300 *ft.; normal range,* 620 *mls.; maximum range,* 808 *mls.; time to* 13,120 *ft.,* 13 *min.; service ceiling,* 23,785 *ft.* **Weights:** *Empty equipped,* 10,340 *lb.; normal loaded,* 17,438 *lb.; maximum loaded,* 18,960 *lb.* **Dimensions:** *Span,* 66 *ft.* 6 *in.; length,* 58 *ft.* 6¾ *in.; height,* 13 *ft.* 5 *in.; wing area,* 581.25 *sq. ft.*

BLOCH 134 — FRANCE

On December 17, 1936, the *Service Technique de l'Aéronautique* issued *Edition No. 1 du Programme Technique A 21* calling for a four-seat medium bomber, and early in 1937, the Société Nationale de Constructions Aéronautiques du Sud-Ouest (SNCASO) began the construction at Courbevoie of the Bloch 134 B4 that had been designed by the former Bloch team to meet the requirements of the new programme. The aircraft resembled the Bloch 133 which was being readied for flight testing, although there was no commonality of components. The fuselage was deeper than that of the Bloch 131 and 133, featuring a step in the upper decking to accommodate the dorsal 20-mm. cannon demanded by the specification, and power was to be provided by two 1,250 h.p. Gnôme-Rhône 14P 14-cylinder air-cooled radial engines. First flight trials were scheduled for the second half of 1937, but by the spring



of that year it had become obvious that the French Air Staff favoured the already existing and highly promising LeO 45 which had been developed to the requirements of the November 1934 specification, and the SNCASO decided, therefore, to abandon further work on its medium bomber contender in order to concentrate on the development of an entirely new design that would be more competitive with the Lioré-et-Olivier prototype.

The new design, which was evolved under the direction of Henri Deplante, and was, in some respects, an extrapolation of the smaller Bloch 170, retained the designation Bloch 134 B4, although it bore no relationship to its predecessor. A clean cantilever low-wing all-metal monoplane powered by two Gnôme-Rhône 14N 48/49 engines driving 10 ft. 10 in. diameter Ratier airscrews, the Bloch 134 could accommodate a 2,976-lb. bomb load internally. The oval-section fuselage housed the bombardier-navigator in the extreme nose, the pilot being seated ahead of the bomb-bay with the radio-operator and gunner seated in tandem aft, the latter having a 20-mm. Hispano-Suiza cannon on a power-operated mounting. The wing, the centre section of which was built integral with the fuselage,

was a torsion box structure, and housed fuel tanks with a total capacity of 567.5 Imp. gal.

The **Bloch 134 No. 01** was built at the SNCASO (Société Nationale de Constructions Aeronautiques du Sud-Ouest) plant at Courbevoie, and assembled at Villacoublay where it was flown for the first time on July 22, 1939. Only marginally smaller than the LeO 451, the Bloch 134 was nearly 20 per cent lighter and, with the same power and payload, offered an improvement in performance. However, by that time the LeO 451 was already in large-scale production. In November 1939, the endplate vertical tail surfaces were enlarged to rectify some instability, and it was proposed to install similar Gnôme-Rhône 14R 0/1 engines to those being fitted to the prototype LeO 455. With two-speed superchargers and offering 1,375 h.p. at 8,350 ft. and 1,230 h.p. at 16,400 ft., these engines were expected to endow the Bloch 134 with a quite spectacular performance, and, in January 1940, the prototype entered the *Centre d'Essais du Matériel Aérien* (CEMA) at Orléans-Bricy. While flying from Orléans-Bricy on April 21, 1940, an explosion in the pressure tank of the hydraulic jack of one undercarriage leg resulted in the leg swinging freely during the landing approach, and collapsing as the aircraft touched down. The prototype suffered some damage but it is uncertain if repairs had been completed when German forces occupied Orléans, and the subsequent fate of the Bloch 134 No. 01 is unknown.

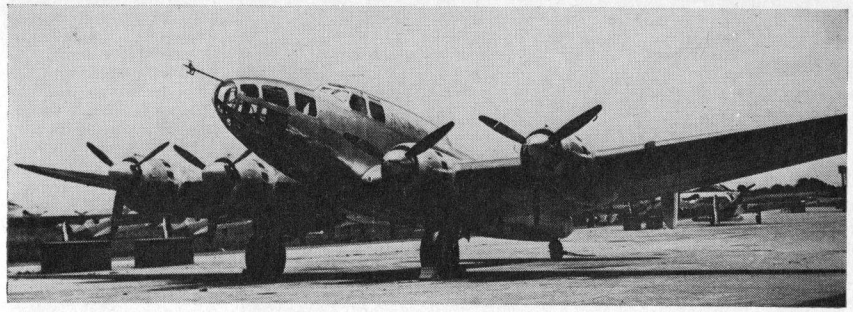
In the following specification figures quoted in parentheses are the estimates of the manufacturer for the Bloch 134 fitted with Gnôme-Rhône 14R engines.

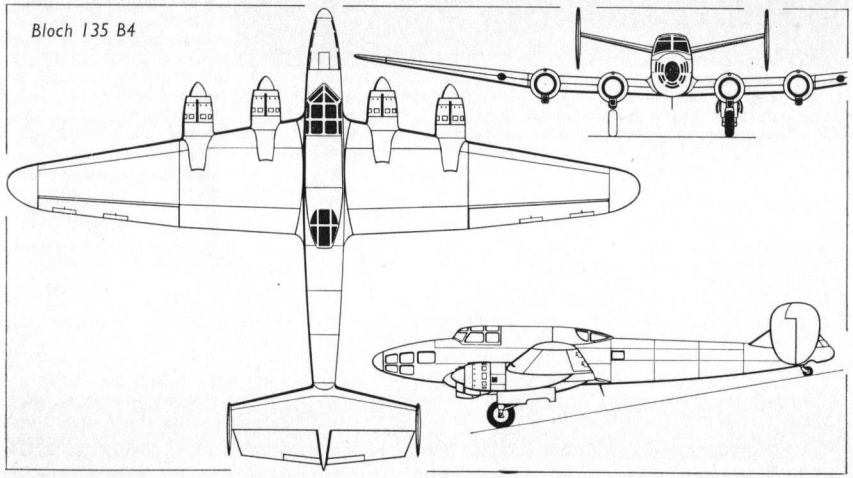
BLOCH 134 B4 SPECIFICATION

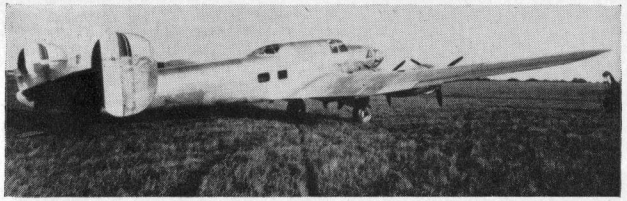
Type: *Four-seat Medium Bomber.* **Power Plants:** *Two Gnôme-Rhône* 14*N* 48/49 14-*cylinder radial air-cooled engines each rated at* 1,140 *h.p. for take-off and* 1,035 *h.p. at* 15,750 *ft.* **Armament:** (*Defensive*) *One fixed forward-firing* 7.5-*mm. MAC* 1934 *machine gun with* 500 *rounds, one* 20-*mm. Hispano* 404 *cannon with* 120 *rounds on power-operated flexible dorsal mounting, and one* 7.5-*mm. MAC* 1934 *machine gun with* 800 *rounds firing from ventral trap.* (*Offensive*) *Internal bomb-bay housing* (*when* 445 *Imp. gal. fuel carried*) 96 22-*lb.*, 24 110-*lb.*, *eight* 220-*lb.*, *or six* 440-*lb. bombs, or* (*when* 567.5 *Imp. gal. fuel carried*) 64 22-*lb.*, 16 110-*lb.*, *eight* 220-*lb.*, *or four* 440-*lb. bombs.* **Performance:** *Maximum speed,* 323 (351) *m.p.h. at* 16,400 *ft.; range at* 275 (298) *m.p.h.*, 1,678 (1,367) *mls. with* 567.5 *Imp. gal. fuel, or* 1,243 (965) *mls. with* 445 *Imp. gal. fuel.* **Weights:** *Empty,* 14,312 (15,304) *lb.; loaded,* 21,662 (22,655) *lb.* **Dimensions:** *Span,* 70 *ft.* 5¼ *in.; length,* 52 *ft.* 9 *in.; wing area,* 661.98 *sq. ft.*

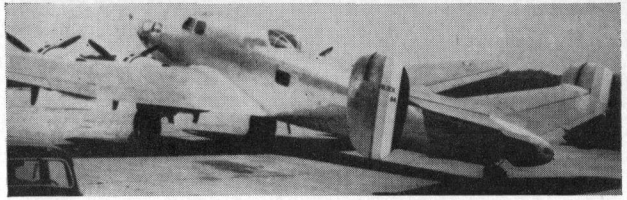
BLOCH 135 FRANCE

During the years preceding the Second World War, the world's air arms had, with the sole exception of Italy's *Regia Aeronautica*, standardised on the twin-engined formula for the medium bomber. The Italian air arm had been attracted to the trimotor on the score of the higher performance that could be attained with power plants of relatively low output, and the reduced combat attrition that might reasonably be expected as a result of the

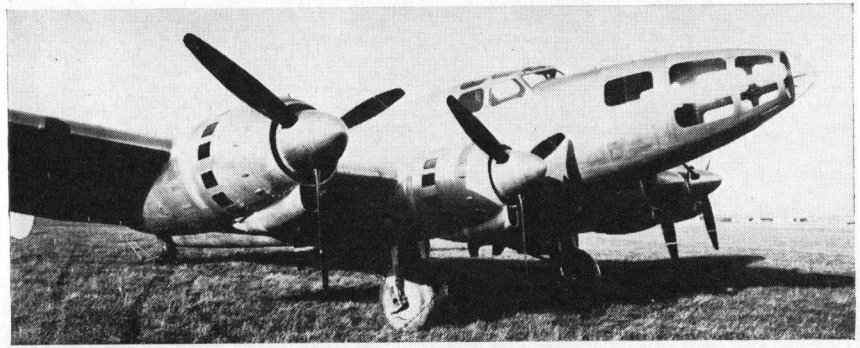








(*Above and below*) *The sole example of the Bloch* 135 *B*4 *four-engined bomber*



improved safety factor, but other air forces believed implicitly in the need for some defensive nose armament to defend the bomber against frontal attacks, and an engine in the fuselage nose rendered the provision of such difficult. The Société Nationale de Constructions Aéronautiques du Sud-Ouest (SNCASO) at Courbevoie took medium bomber design an interesting stage further with the **Bloch 135 B4** which mounted no fewer than *four* engines, and thus, when flown on January 12,

1939, this warplane was unique among medium bombers.

Although widely believed to be a scaled-down derivative of the Bloch 162 B5 heavy bomber, the Bloch 135 bore no design relationship to the larger aircraft, being a parallel development to the twin-engined Bloch 134 B4 and meeting essentially similar requirements. When, early in 1937, the former Bloch team at Courbevoie began working on a twin-engined medium bomber to fulfil the demands of the A 21 programme, a four-engined version of the same basic design was evolved in parallel, the principal difference between the two aircraft being the wing centre section, that of the Bloch 134 carrying two Gnôme-Rhône 14P radials and that of the Bloch 135 carrying four low-powered small-diameter Gnôme-Rhône 14Ms. When the decision was taken to abandon the original Bloch 134 design in favour of a completely new development, work on the Bloch 135 continued, and thus there was to be little in common between this and the twin-engined bomber designated Bloch 134 that was to fly in July 1939.

The Bloch 135 possessed a clean, oval-section dural monocoque fuselage accommodating four crew members and a 2,970-lb. bomb load in a fuselage bay between the main spars. The wing was of typical Bloch two-spar torsion-box construction with oblique ribs, the centre section housing tanks for a maximum of 682 Imp. gal. of fuel and carrying the four Gnôme-Rhône 14M engines (right-hand rotation 14M 6s to port and left-hand rotation 14M 7s to starboard) which drove Gnôme-Rhône variable-pitch three-bladed airscrews.

The **Bloch 135 No. 01** was assembled at Villacoublay late in 1938, and flown there by the SNCASO chief test pilot Le Bail on January 12, 1939. During the following month some modifications were made to the tail assembly, but although subsequent flight testing revealed an extremely promising performance and pleasant handling characteristics, no decision concerning production of the bomber had been taken by the time the Second World War began. Subsequently, the *Armée de l'Air* decided that the twin-engined LeO 45 and Amiot 350 series of medium bombers fully met its immediate requirements, and the advantages of standardisation motivated against introducing a third medium bomber onto the assembly lines.

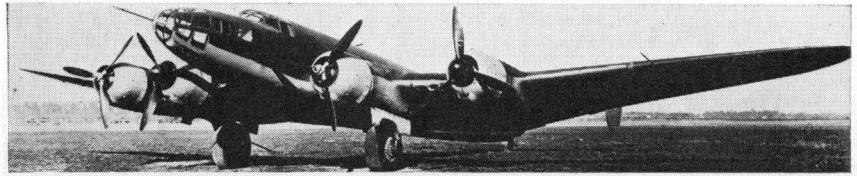
BLOCH 135 B4 SPECIFICATION

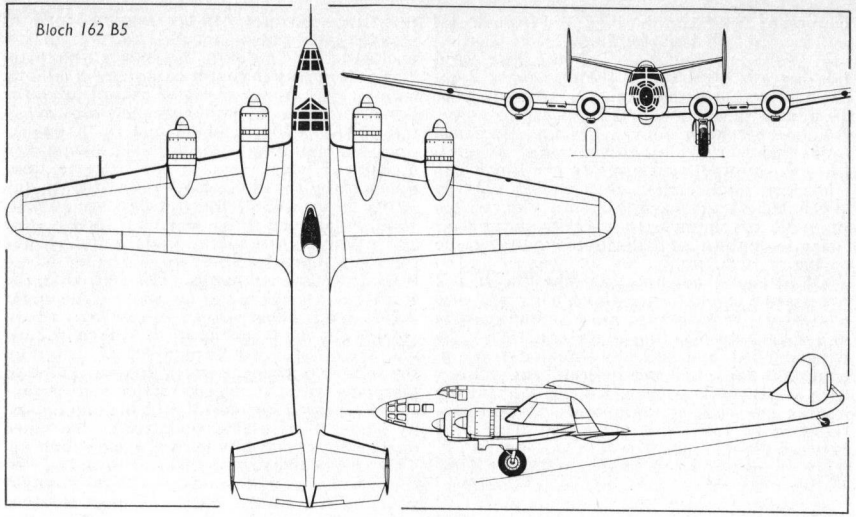
Type: *Four-seat Medium Bomber.* **Power Plants:** *Four Gnôme-Rhône* 14*M* 6/7 14-*cylinder radial air-cooled engines each rated at* 700 *h.p. for take-off and* 660 *h.p. at* 13,200 *ft.* **Armament:** (*Defensive*) *One* 7.5-*mm. MAC* 1934 *machine gun with* 500 *rounds on flexible mounting in nose, one* 20-*mm. Hispano-Suiza cannon on power-operated mounting with* 180 *rounds in dorsal position, and one* 7.5-*mm. MAC* 1934 *machine gun with* 800 *rounds on flexible mounting in ventral position.* (*Offensive*) *Maximum internal bomb load of* 2,970 *lb.* **Performance:** *Maximum speed,* 311 *m.p.h. at* 16,400 *ft.; normal cruising speed,* 264 *m.p.h. at* 16,400 *ft.; range at* 264 *m.p.h. with* 682 *Imp. gal. fuel and* 1,984-*lb. bomb load,* 1,243 *mls., with* 528 *Imp. gal. fuel and* 2,970-*lb. bomb load,* 840 *mls.; time to* 16,400 *ft.,* 9.5 *min.; service ceiling,* 32,810 *ft.* **Weights:** *Empty,* 12,875 *lb.; normal loaded,* 21,903 *lb.; maximum,* 25,353 *lb.* **Dimensions:** *Span,* 69 *ft.* 9⅜ *in.; length,* 50 *ft.* 0⅛ *in.; height,* 12 *ft.* 10 *in.; wing area,* 652.292 *sq. ft.*

In view of the many subscribers in the pre-war French Air Staff to the theories on strategic air power propounded by the Italian General Douhet, it is at first sight surprising that the production of the multi-engined strategic bomber should have been largely neglected during the 'thirties in France of all countries. Indeed, what development of such warplanes as *was* undertaken revealed a peculiarly sentimental regard on the part of the French for a configuration obviously outmoded by world progress. The lack of emphasis on strategic heavy bomber design was due to two factors. The first of these factors was financial; the *Armée de l'Air* being treated anything but generously by the defence budgets of the period. The second factor was a misplaced faith in the twin-engined *multiplaces de combat*—a relatively inexpensive materialization of the Douhetian concept considered to be capable of attacking any part of a potential enemy's territory from French bases and from bases on the territory of countries which, it was assumed, would automatically become France's allies in the event of a conflict.

The fact that one modern four-engined strategic bomber *was* under test in France at the time of the Armistice in 1940 was due to no belated admission on the part of the French government of its error in having failed to ensure the modernity of the *Armée de l'Air* strategic bombing component, but rather to coincidence, the SNCASO having evolved a design for a long-range mailplane which proved amenable to adaptation for the strategic bombing role specified by *Programme Technique A 20*.

During 1937, the former Avions Marcel Bloch design team at Courbevoie, which was continuing to develop designs initiated before the Nationalisation Law of 1936 had transformed the company into the Société Nationale de Constructions Aéronautiques du Sud-Ouest (SNCASO), was involved in preliminary work on two derivatives of the **Bloch 160** four-engined 12-passenger commercial tansport which had been ordered in 1936 for operation over the colonial routes of Air Afrique. The Bloch 160 was powered by four Hispano-Suiza 12Xirs 12-cylinder liquid-cooled engines rated at 720 h.p. at 6,560 ft., but its payload-range characteristics and cruise performance left considerable room for improvement. It had been decided, therefore, to adopt Gnôme-Rhône 14N air-cooled radial engines rated at 900 h.p. at 7,546 ft., redesign the fuselage to accommodate 33 passengers, and introduce a new tail assembly incorporating twin fins and rudders. The basic wing structure was retained but the outer panels were lengthened, increasing the gross wing area from 1,130 sq. ft. to 1,194.8 sq. ft. This development had been designated **Bloch 161** and, simultaneously, the design team had evolved the **Bloch 162 Raid** which, utilising similar wings, tail surfaces and undercarriage married to a fuselage of reduced cross section and increased fineness ratio, was intended for mail-carrying and communications tasks over distances up to 4,350 miles.





The Bloch 162 promised an exceptional performance, and at an early stage consideration was given to the possibility of adapting the design as a long-range heavy bomber. The proposed **Bloch 162 B5** five-seat bomber offered the *Service Technique de l'Aéronautique* bid fair to give a superior performance to that of any comparable aircraft extant or known to be under development elsewhere. A little smaller than the Boeing YB-17 then being delivered to the U.S. Army Air Corps, having some 10 per cent less wing span and area, but marginally heavier and appreciably faster if somewhat shorter on range than the American bomber, the Bloch 162 B5 conformed with the French predilection for heavier, longer-ranging defensive armament than the small-calibre machine guns standardised for most bombers, provision being made for 20-mm.

cannon on flexible mountings fired from dorsal and ventral "blister" positions.

A full-scale mock-up of the projected bomber was displayed at the *Salon de l'Aéronautique* which opened in Paris in November 1938, at which time it was proposed to power the bomber with four 1,100 h.p. Hispano-Suiza 14AA 12/13 air-cooled radial engines, but priority had been given to the Bloch 161 transport, and actual construction of the **Bloch 162-01** at the SNCASO's Courbevoie plant did not commence until 1939, the aircraft being assembled at Villacoublay during the spring of 1940.

Of all-metal construction, the Bloch 162 possessed a characteristic Bloch wing structure of two-spar torsion-box type with oblique ribs and detachable leading-edges and tips. The wing carried hydraulically-actuated trailing-edge split flaps, and was built in four sections with Vedal sheet covering, the fuel tanks being housed between the main spars, a maximum fuel load of 1,430 Imp. gal. being distributed between eight tanks. The fuselage was an all-metal monocoque and accommodated a crew of five comprising pilot, co-pilot, navigator-bombardier, radio operator-gunner, and dorsal gunner, and the mechanically-operated main undercarriage members retracted forward into the inner engine nacelles, and were partly enclosed by twin doors. Defensive armament was noteworthy in that it comprised a 20-mm. cannon on a power-operated mounting in the dorsal position, a similar weapon plus a 7.5-mm. MAC 1934 machine gun on a power-operated mounting in the ventral position, and a single 7.5-mm. gun in the extreme nose operated by the navigator-bombardier.

The Bloch 162-01 did not fly until June 1, 1940, by which time German forces were approaching Villacoublay, and the aircraft was therefore flown to Bordeaux-Mérignac where it fell into German hands. The SNCASO, the Bordeaux-Mérignac plant of which came under Focke-Wulf supervision, was instructed to resume the flight testing of the Bloch 162-01, and tests continued throughout 1942, but in the following year the prototype was flown to Germany where it entered service with the so-called *Gruppe* Gartenfeldt which, commanded by Major Gartenfeldt, undertook long-range clandestine operations, such as agent dropping. This unit became I/KG 200 in February 1944, the sole Bloch 162 forming part of the strength of 1. *Staffel* at Finow, but its subsequent fate is unknown.

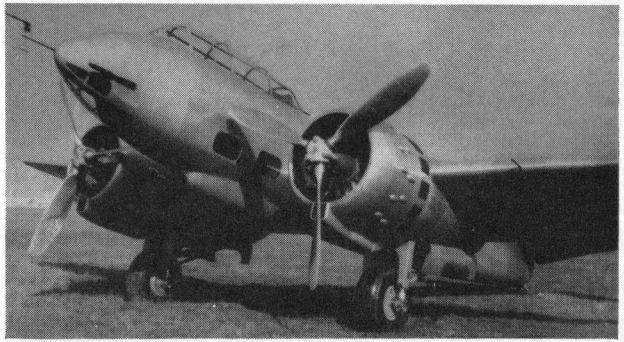
BLOCH 162 B5 SPECIFICATION

Type: *Five-seat Long-range Heavy Bomber.* **Power Plants:** *Four Gnôme-Rhône* 14*N* 48/49 14-*cylinder two-row radial air-cooled engines each rated at* 1,100 *h.p. for take-off and* 1,030 *h.p. at* 7,220 *ft.* **Armament:** (*Defensive*) *One* 7.5-*mm. MAC* 1934 *machine gun on flexible mount in nose with* 800 *rounds, one* 20-*mm. Hispano-Suiza cannon on flexible mount with* 180 *rounds in dorsal position, and one* 20-*mm. Hispano-Suiza cannon with* 180 *rounds plus one* 7.5-*mm. MAC* 1934 *machine gun with* 800 *rounds* (*on flexible mount*) *in ventral position.* (*Offensive*) *Maximum bomb load of* 7,937 *lb.* **Performance:** *Maximum speed,* 342 *m.p.h. at* 18,045 *ft.; range* (*with* 7,937-*lb. bomb load and* 836 *Imp. gal. fuel*), 870 *mls.,* (*with* 3,527-*lb. bomb load and* 1,430 *Imp. gal. of fuel*), 1,490 *mls.; time to* 6,560 *ft.,* 5 *min.* 48 *sec., to* 16,400 *ft.,* 18 *min.; ceiling,* 29,530 *ft.* **Weights:** *Empty,* 26,158 *lb.; loaded,* 41,888 *lb.* **Dimensions:** *Span,* 92 *ft.* 2 *in.; length,* 71 *ft.* 10½ *in.; height,* 12 *ft.* 4 *in.; wing area,* 1,173.265 *sq. ft.*

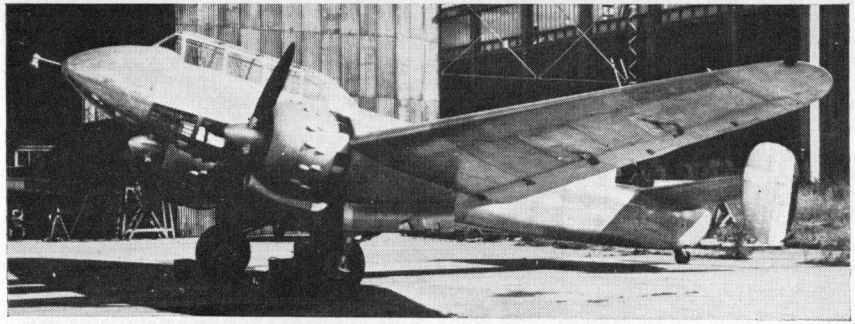
The years immediately preceding World War II saw France's aircraft industry evolving a number of elegant, well-built and well-planned combat aircraft which refuted the widespread contention that the French had an eye for beauty in anything *but* a warplane. World events were to deny these aircraft the long and distinguished operational careers that they justified for, unfortunately, their numbers were too small to affect seriously the outcome of the Battle of France in 1940. The *Armée de l'Air* was forced to sustain operations with obsolescent aircraft while endeavouring to convert to the modern warplanes that were at last rolling from French assembly lines. Among the best of these new warplanes was the Bloch 174 which had begun to reach the *Groupes de Reconnaissance* less than two months before the German onslaught commenced.

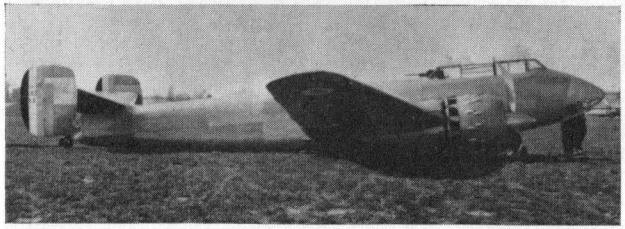
Designed under the supervision of Henri Deplante of the Société Nationale de Constructions Aéronautiques du Sud-Ouest (SNCASO) at Courbevoie, the Bloch 174 was comparable with any aircraft in its category extant at the time of its service début. Its design stemmed from that of the Bloch 170, a multi-purpose two- or three-seater, development of which had begun late in 1936. The first prototype, the **Bloch 170 AB2 A3 No. 01** (*Assaut Bombardement—Biplace/Armée—Triplace*), had flown for the first time on February 15, 1938 at Villacoublay.

The Bloch 170 followed broadly the concept of the Junkers Ju 88; a clean, twin-engined low-wing cantilever monoplane, the fuselage of which accommodated a closely-grouped crew well forward and a bomb-bay of negligible size, and featured an abbreviated raised cockpit and a small cupola mounted centrally beneath the cockpit and intended to house a camera or a single rear-firing 7.5-mm. machine gun. Its wing was of characteristic Bloch



Predecessor of the Bloch 174, *the Bloch* 170 *No.* 01 *was a multi-purpose two- or three-seater which commenced flight trials at Villacoublay in February* 1938





(Above) The Bloch 170 B3 No. 02 three-seat high-speed bomber, and (left) the Bloch 170 AB2 A3 No. 01 after its crash landing at Villacoublay

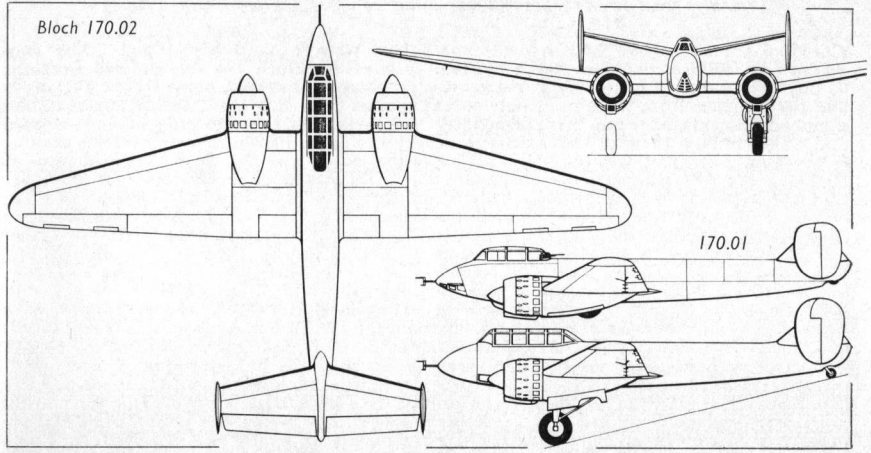
structure of two-spar torsion-box type with oblique ribs and detachable leading-edges and tips, built in three sections, the rectangular centre-section being built integral with the fuselage and housing all fuel. The fuselage was an oval-section monocoque with stressed Vedal sheet covering, and the retractable undercarriage was hydraulically-operated, the main members featuring twin oleo legs with inclined struts raising the wheels aft into the nacelles of the two Gnôme-Rhône 14N 6/7 14-cylinder radials which were each rated at 950 h.p. at 12,170 ft. and 970 h.p. at 15,000 ft. Armament comprised one fixed forward-firing 20-mm. Hispano-Suiza cannon mounted in the portside of the nose, two wing-mounted 7.5-mm. MAC 1934 machine guns and two similar weapons on flexible mounts firing aft from the rear cockpit and the ventral cupola.

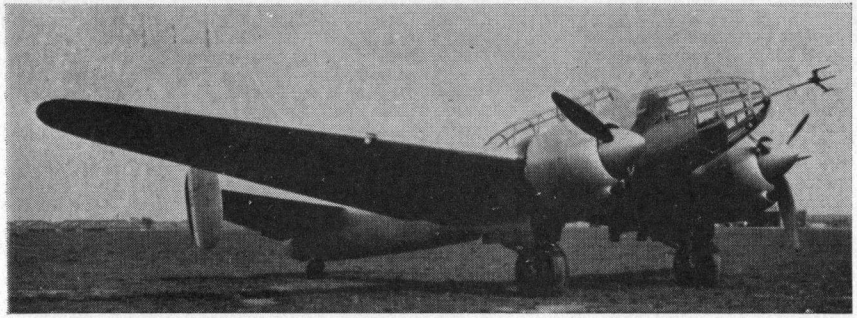
The first prototype was damaged as a result of a crash landing sustained at Villacoublay on March 17, 1938, but the test programme was resumed shortly afterwards with a second and much modified prototype, the **Bloch 170**

B3 No. 02 (*Triplace de Bombardement*). Also built at Courbevoie, this aircraft was intended specifically for the high-speed bombing role. The drag-evoking ventral gondola that had been intended primarily to house the camera (for the *Armée* or co-operation role) had been deleted, extensive glazing had been incorporated in the underside of the forward fuselage, the length of the "glasshouse" enclosing the cockpits had been substantially increased, and the endplate vertical tail surfaces had been enlarged.

By the time the Bloch 170 B3 No. 02 joined the test progamme, there had been a number of changes in French Air Staff requirements. The SNCASO design bureau had evolved several variants of the basic design, both as two- and three-seaters, with alternative power plants and for such roles as heavy fighter, these including the Bloch 171, 172 and 173, but these had progressed no further than the drawing board as Air Staff interest had crystallized on a derivative designated Bloch 174, the primary tasks of which were reconnaissance and target-marking, although some secondary bombing capability was incorporated.

Final assembly of the prototype of the new model, the **Bloch 174 No. 01,** was undertaken at Villacoublay where the aircraft flew for the first time on January 5, 1939. While the wing planform, undercarriage, tail surfaces and basic structure remained essentially unchanged from those of the Bloch 170 B3 No. 02, the fuselage of the Bloch 174 was extensively re-designed, the raised "glasshouse" enclosure was moved aft and the nose was extensively

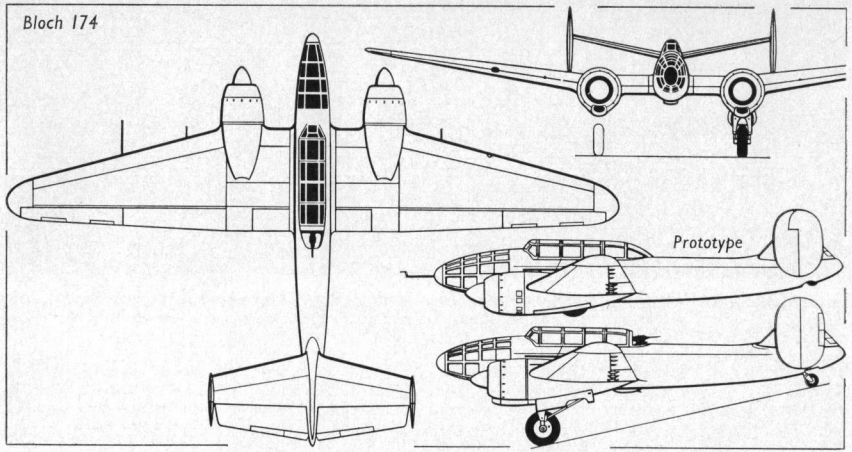




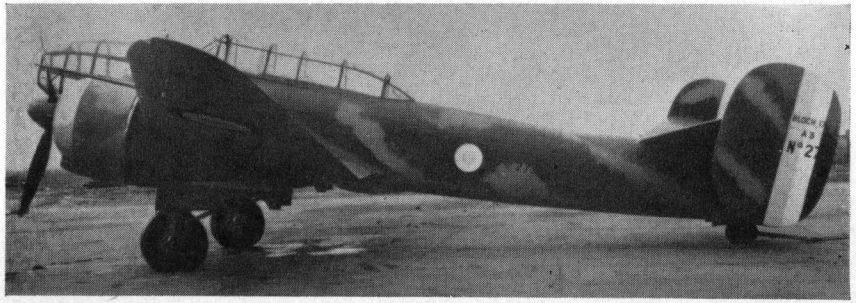
The Bloch 174 *A*3 *No.* 1, *the first of six pre-production machines. The aircrew spinners were later reduced in size owing to unsatisfactory engine cooling*

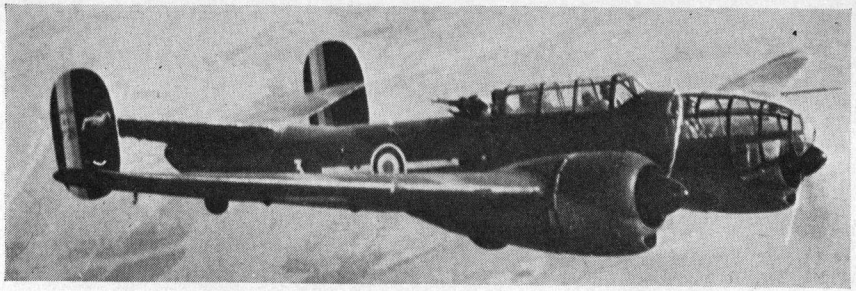
glazed. Powered by two 1,030 h.p. Gnôme-Rhône 14N 20/21 engines, the Bloch 174 No. 01 displayed excellent handling characteristics and performance from the outset, only some minor adjustments to the tabs being demanded, and on February 1, 1939, the *Ministère de l'Air* placed a contract with the SNCASO for 50 Bloch 174 A3s, a six-machine pre-production batch having been previously ordered. Several sub-contractors were appointed for Bloch 174 production, the wing outer panels being manufactured by the SNCAO plant at Nantes-Bouguenais, the fuselage/wing centre section being produced by the SNCASO Bordeaux-Bègles factory, the rear fuselages by Entreprises Industrielles Charentaises at Aytré, and the tail assemblies by SNCASO at Rochefort-sur-Mer, final assembly taking place at the Bordeaux-Mérignac plant of the SNCASO.

The pre-production aircraft were, like the prototype, assembled at Villacoublay where they were exhaustively tested. The pre-production Bloch 174 A3s differed from the prototype in having Gnôme-Rhône 14N 48/49 engines with Bronzavia thrust augmentation exhaust stacks, these boosting maximum speed by 12 m.p.h. However, unsatisfactory cooling experienced with the **Bloch 174 No. 1** resulted in the provision of airscrew spinners of smaller diameter. The first production aircraft, **Bloch 174 A3 No. 7**, was assembled at Bordeaux-Mérignac and flown on November 5, 1939, and by early February 1940, 20 aircraft had been accepted by the *Armée de l'Air*, although none had been delivered to any unit. However, during February these aircraft were all returned to Mérignac for armament modifications. During the previous December a Bloch 174 had been tested at Cazaux with three belt-fed MAC 1934 M39 machine guns beneath the fuselage on wobble-mounts firing aft at various angles. The success of these trials coupled with operational reports from Potez



(*Below*) *Bloch* 174 *A*3 *No.* 27, *the* 21*st production aircraft at Bordeaux-Mérignac*

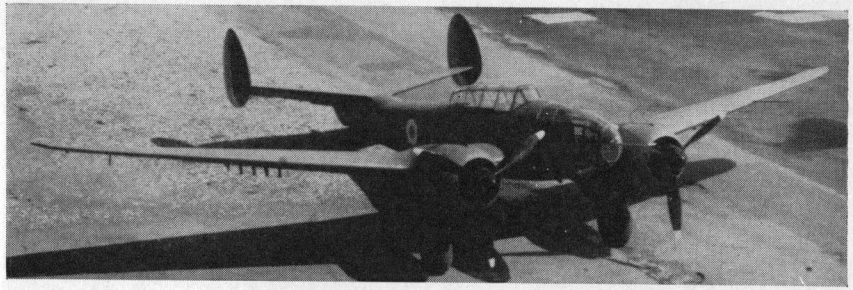




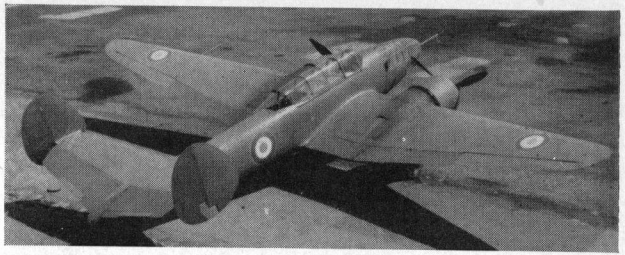
(*Above and at foot of page*) *Bloch* 174 *A3s of GR II*/33 *of the Vichy-controlled Armée de l'Air based at Tunis-El Aouina. The* 2e *Escadrille retained the Bloch* 174 *until June* 1943

637-equipped units led to the decision to standardise on this installation which was fitted at Mérignac. Simultaneously, the single 7.5-mm. weapon on a flexible mount in the rear cockpit was supplanted by twin guns of similar calibre, and some armour was fitted.

In the meantime, the undoubted qualities of the basic design had led to an Air Staff requirement for a bomber version which had already begun to supplant the Bloch 174 in production in two variants, the Bloch 175 and 176. Intended primarily for reconnaissance duties,



(*Above and right*) *The Bloch* 174 *No.* 53 *fitted with air brakes and smaller vertical tail surfaces as part of the experimental programme leading to the Bloch* 175*T for the Aéronavale*

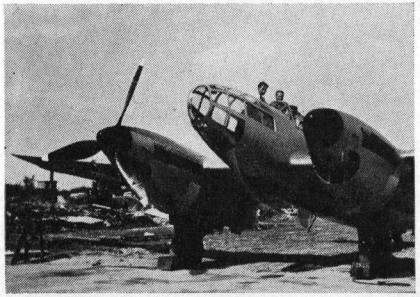


the Bloch 174 possessed only a small bomb-bay capable of accommodating eight 110-lb. bombs, and as priority was given to the production of bombers from September 1939, no further orders had been placed for the reconnaissance model, the 50th and last production example of which left the Mérignac assembly line in May 1940.

OPERATIONAL CAREER

After the completion of armament modifications, Bloch 174 A3 Nos. 16, 18 and 21 were delivered on March 19, 1940 to the *Groupe de Reconnaissance* II/33, and on the 29th of the same month the first operational sortie with this type was flown by *Capitaine* de Saint-Exupéry. GR I/52 received its first three Bloch 174s on April 7th, and deliveries to GR I/33 and II/36 had begun by the end of the month. The pilots were impressed by the aircraft's take-off and landing characteristics, and the high performance and excellent manoeuvrability of the Bloch 174 soon proved of inestimable value in combat, very few aircraft of this type being lost to *Luftwaffe* fighters.

(Above and below left) The Bloch 174*Z, originally Bloch* 174 *A*3 *No.* 20, *re-engined with Hispano-Suiza* 12*Z equipped with Turboméca PV.*19*B turbo-superchargers*



By June 18, 1940, GR II/33 was completely equipped with the Bloch 174, but most other *Groupes de Reconnaissance* were operating a mixture of various types. For example, on June 20th GR I/52 flew two Bloch 174s, one Potez 637, four Potez 63.11s, four Breguet 693s and two Dewoitine 520s across the Mediterranean, although *officially* equipped with the Potez 63.11. GR I/55 possessed a mixture of six Bloch 174s, 175s and 176s when it arrived at Oran-La Sénia, while, on June 22nd, when GR I/36 took off from the South of France, the unit possessed one Bloch 174, three Potez 63.11s, and one Bre 693.

The only Bloch 174-equipped unit permitted the Vichy-controlled *Armée de l'Air* was

GR II/33 based at Tunis-El Aouina, and early in 1942 this unit's aircraft were fitted with ventral racks for a single 551-lb. bomb which was intended to be released in a shallow diving attack. A similar installation for a 1,102-lb. bomb was subsequently tested, and this was to prove extremely effective during the Tunisian campaign in which GR II/33 participated with reconnaissance and attack sorties. The 1ere *Escadrille* of GR II/33 received its first two F-4 Lightnings on March 30, 1943, progressively handing over its Bloch 174s to the 2e *Escadrille*, until, on June 17, 1943 all remaining aircraft of this type were passed to the *École d'Application du Personnel Navigant* at Marrakesh.

Several Bloch 174s were still active by VE Day, and the 47th production aircraft (Bloch 174 A3 No. 53) was to be flown from North Africa to Châteauroux-Déols in November 1945 for conversion as a test-bed for use in connection with the Bloch 175T development programme. This aircraft was fitted with wing trailing-edge air brakes moving backward and rotating so as to present a flat surface to the slipstream disposed equally above and below the wing. The vertical tail surfaces were re-designed and increased in area, and rocket stubs were fitted beneath the outer wing panels. Another survivor of World War II, Bloch 174 No. 20, was re-engined with Hispano-Suiza 12Z 12-cylinder liquid-cooled engines as the **Bloch 174Z**. Some preliminary experimental work for fitting the HS 12Z to the Bloch 175 airframe had been undertaken by the SNCASO in 1942 when it was estimated that this engine would result in a maximum speed of 404 m.p.h. at 29,530 ft., but the Bloch 174Z did not fly until August 13, 1947, and after preliminary trials at Châteauroux-Déols, was flown to Villacoublay on October 7th. As installed in the Bloch 174Z, the fuel-injection HS 12Z engines with their two-speed Turboméca PV.19B turbo-superchargers provided 1,300 h.p. at 26,240 ft. in H.S. gear and 1,600 h.p. at 8,200 ft. in M.S. gear, and during some 50 flights the aircraft attained a maximum speed of 373 m.p.h. at 26,240 ft.

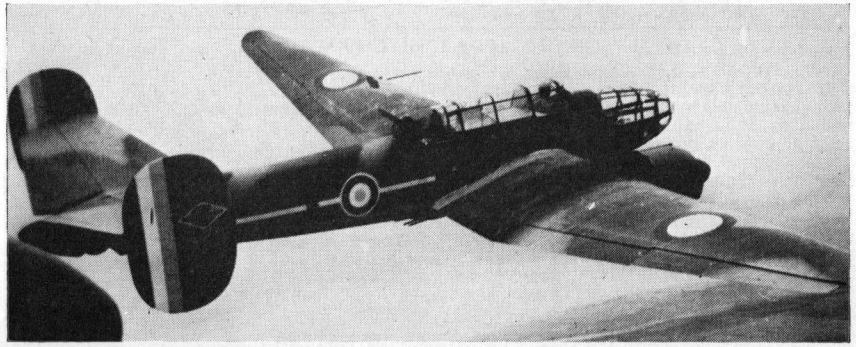
BLOCH 174 A3 SPECIFICATION

Type: *Three-seat Reconnaissance, Target-marking and Light Bombing Aircraft.* **Power Plants:** *Two Gnôme-Rhône* 14*N* 48/49 14-*cylinder air-cooled radial engines each rated at* 1,140 *h.p. for take-off and* 1,035 *h.p. at* 15,730 *ft.* **Armament:** *Two fixed forward-firing* 7.5-*mm. MAC* 1934 *machine guns with* 500 *r.p.g. in wings, two* 7.5-*mm. MAC* 1934 *machine guns with eight* 100-*round drums on flexible SAMM-AB*68 *dorsal mounting, and three* 7.5-*mm. MAC* 1934 *M*39 *machine guns with* 500 *r.p.g. firing aft from ventral wobble-mounts.* (*Offensive*) *Eight* 110-*lb. bombs on two Gardy S*4 × 50 *racks or* 32 22-*lb. bombs on two Gardy S*16 × 10 *racks internally, or two* 66-*lb. and* 16 22-*lb. flares on underwing racks.* **Performance:** *Maximum speed,* 248 *m.p.h. at sea level,* 329 *m.p.h. at* 17,060 *ft.; maximum cruising speed,* 286 *m.p.h. at* 13,120 *ft.; economical cruising speed,* 248 *m.p.h. at* 13,120 *ft.; maximum range* (*reconnaissance mission*), 1,025 *mls.,* (*with* 880-*lb. bomb load*), 800 *mls.; time to* 26,250 *ft.,* 11 *min.; service ceiling,* 36,090 *ft.* **Weights:** *Empty,* 12,346 *lb.; loaded,* 15,784 *lb.* **Dimensions:** *Span,* 58 *ft.* 9½ *in.; length,* 40 *ft.* 1½ *in.; height,* 11 *ft.* 7¾ *in.; wing area,* 409.029 *sq. ft.*

The exceptional performance, manoeuvrability, outstanding handling characteristics and general sturdiness displayed by the Bloch 174 No. 01 reconnaissance aircraft from the beginning of its flight test programme in January 1939 encouraged Henri Deplante's team to evolve a specialized bombing version of the basic design. In view of its intended role, it had not been considered necessary to make provision for bombs larger than the 110-pounder, but to fulfil Air Staff requirements any bomber derivative had to be capable of accommodating 220-lb. and 441-lb. bombs which demanded a somewhat longer bomb-bay, and all differences between the Bloch 174 reconnaissance aircraft and Bloch 175 bomber stemmed from the need to enlarge the bomb-bay of the latter type.

The necessary enlarging of the bomb-bay was complicated by the fact that the fore and aft limits of the existing bay were dictated by the two wing spars which carried through the fuselage. It was therefore necessary to design a new fuselage/wing centre section with sufficient space between the mainspars to permit a bomb-bay of the required length. The forward spar was repositioned slightly further forward and the rear spar was moved aft to increase the gap between the spars by some 15 per cent, but the actual wing root chord was only marginally increased (from 10 ft. 0½ in. to 10 ft. 7 in.), the repositioning of the spars having dictated a narrower-chord leading-edge section, and longer-span, narrower-chord flaps. The transparent sections of the cockpit canopy attaching up to the mainframes

Bloch 175 *B*3 *No.* 114 *of GRII*/52 *based at Oran-La Sénia where most of this aircraft were destroyed on November* 8, 1942 *by Allied ground strafing.*



associated with the spars were lengthened commensurately, and a similar spar repositioning was introduced in the wing outer panels, this dictating the repositioning of the wing guns further outboard and a slight forward sweep on the aileron hinge line. The net changes in the overall dimensions of the aircraft as a result of these extensive modifications were a mere 4.26 sq. ft. increase in gross wing area and a 7 5/16 in. increase in length.

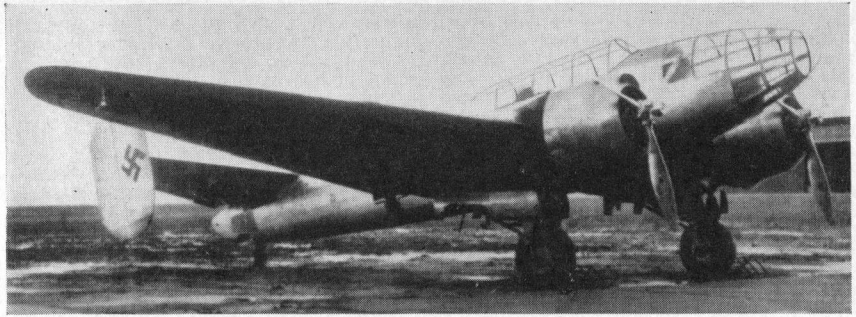
The actual structure of the Bloch 175 remained unchanged from that of the Bloch 174, and the nose section which included the pilot's cockpit, the rear fuselage, tail assembly, power plants and undercarriage were common to both aircraft, and in September 1939, while the prototype was still under construction, an order was placed for no fewer than 1,137 Bloch 175s and a Twin Wasp-powered version, the Bloch 176.

The **Bloch 175 No. 01** was first flown in December 1939 with Daniel Rastel at the controls, and, as had been anticipated, the prototype displayed similar characteristics and performance to those of the Bloch 174. Production of Bloch 175 components progressively supplanted those for the earlier aircraft at the same sub-contractors, and the first production machine, the **Bloch 175 B3 No. 101**, flew in April 1940.

The **Bloch 176 No. 01** had, in fact, preceded the Bloch 175 No. 01, having flown at Villacoublay in September 1939 with René Le Bail at the controls. The Bloch 176 No. 01 was actually a Bloch 174 pre-production airframe with Pratt & Whitney R-1830 SC3-G Twin Wasps each rated at 1,050 h.p. for take-off and 900 h.p. at 12,000 ft., but the production model was to employ the Bloch 175 airframe. The Bloch 176 No. 01 performed its CEMA (*Centre d'Essais du Matériel Aerien*) trials at Orléans-Bricy during the winter of 1939–40. Performance at altitude proved to be markedly inferior to that of the Bloch 175 as a result of the combination of lower-powered engines and the aerodynamic asymmetry countering the torque of both engines rotating in the same direction, maximum speed being only 292 m.p.h. as compared with the 335 m.p.h. of the Gnôme-Rhône 14N-powered aircraft. Nevertheless, it was necessary to economise on the use of the Gnôme-Rhône engines which were also required by several other aircraft types, and production continued at Bordeaux-Mérignac, the first machine, the **Bloch 176 B3 No. 201**, coming off the line in May 1940. Only some five aircraft of this type had been completed, however, when production was stopped on June 25, 1940. Twenty-three Bloch 175s had also been completed, and 200 other airframes were well advanced, while a substantial proportion of the component parts for a further 200 had been manufactured.

Although the Bloch 175 B3 was a bomber, the first production aircraft were delivered in May 1940 to the *Groupe de Reconnaissance* II/52 whose Potez 63.11s had quickly proved incapable of defending themselves against Bf 109E fighters. Like the Bloch 174, it rapidly achieved popularity with *Armée de l'Air* pilots on the score of its excellent handling characteristics, both on the ground and in the air, and its outstanding manoeuvrability, and GR II/52, which had received 11 Bloch 175s by June 19, 1940, suffered few losses on operations.

GR II/52 subsequently flew to North Africa, and several Bloch 175s ready for collection at Bordeaux-Mérignac were taken over by various retreating units and also flown to North Africa, together with one of the Bloch 176s which eventually found its way onto the strength of the Bloch 174-equipped GR II/33 at Tunis-El Aouina. GR II/52 was subsequently based at Oran-La Sénia where most of the unit's Bloch 175s were destroyed by



One of the few Bloch 176 B3 light bombers completed at Bordeaux-Mérignac and evaluated by the Luftwaffe

Allied ground strafing on November 8, 1942. The unit provisionally converted to Douglas DB-7s in January 1943, pending availability of Marauders, handing its surviving Bloch 175s over to GR II/33 which continued to operate them alongside Bloch 174s and the sole Bloch 176 throughout the Tunisian campaign, eventually passing them to the *Ecole d'Application du Personnel Navigant* at Marrakesh on June 17, 1943

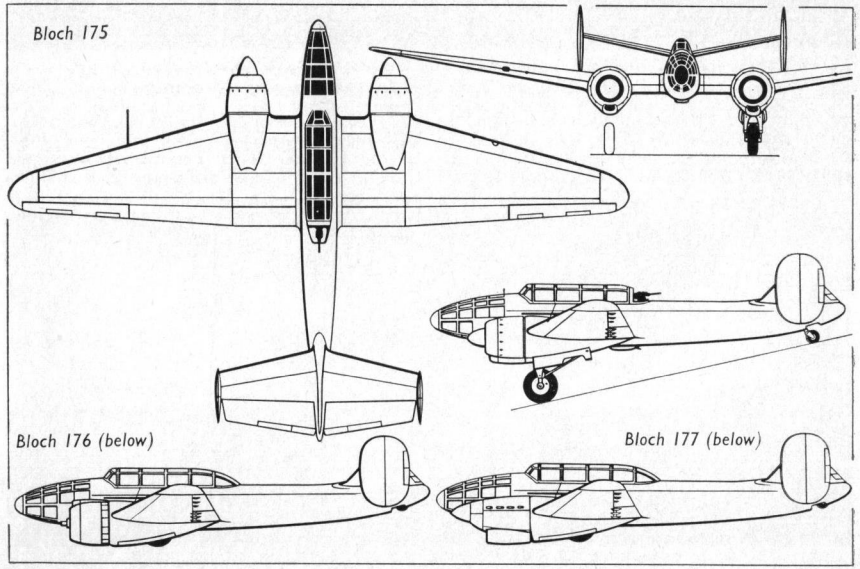
FURTHER DEVELOPMENT

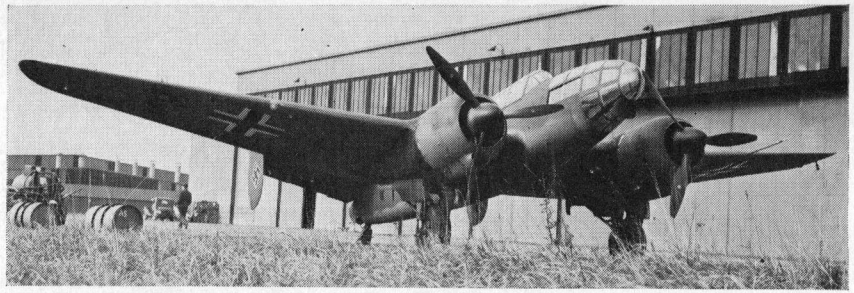
The Bordeaux group of SNCASO factories was placed under Focke-Wulf control in July 1940, and production of the Bloch 175 was resumed after the *Reichsluftfahrtministerium* had evaluated the aircraft and pronounced it acceptable for *Luftwaffe* use as an operational trainer, the Bordeaux-Mérignac plant being instructed to complete the 200 aircraft already well advanced. Between October 1940 and June 1941, precisely 56 Bloch 175s were completed and despatched to Germany, while a considerable number of additional machines had been completed and awaited collection or were virtually complete. Then instructions were received at Mérignac that the Gnôme-Rhône engines, complete with airscrews, radiators, cowlings, and all wiring were to be removed from the Bloch 175 airframes, and despatched to one of the Messerschmitt plants immediately.

By robbing the Bloch 175s of their power plants, the Germans were faced with the problem of what to do with a large number of engineless airframes at Mérignac. As some stock of Hispano-Suiza 12Y 31 12-cylinder liquid-cooled engines was available, it was elected to install this power plant in the Bloch 175, the modified aircraft being designated **Bloch 177**. The HS 12Y 31 was not a very suitable choice as it necessitated an entirely new engine mount. Furthermore, it offered only 830 h.p. for take-off and 860 h.p. at 10,660 ft.,

and when the Bloch 177 prototype conversion was flown in the late autumn of 1941, it was found to possess a maximum speed of only 292 m.p.h. at 13,120 ft.

So much time was spent testing the prototype that trials were not completed until March 1942, by which time the German authorities had become bored with the entire programme and, anxious to have the factory space for Fw 189 production, made a present of the remaining engineless airframes to the Vichy government, suggesting that they should be transferred to the Châteauroux-Déols plant. The Vichy *Secrétariat d'Etat de l'Air* had earlier decided to manufacture 300 Bloch 175s for the *Armée de l'Air* at the Châteauroux-Déols plant and, the German authorities having given the plan their approval, was awaiting transfer of the necessary jigs and tools from the Occupied Zone. It was assumed that the engineless airframes at Mérignac would satisfy a part of the Vichy order but, sur-





(*Above and at foot of page*) *One of the fifty-six Bloch* 175*s delivered to the Luftwaffe between October* 1940 *and June* 1941 *for use as operational trainers.*

prisingly, the French authorities decided to effect the transfer by *flying* the aircraft to Châteauroux-Déols. The airframes had already been fitted with engine mounts to take the Hispano-Suiza 12Y but at the time only a half-dozen of these power plants were available to the French. They accordingly mounted these in three of the airframes, flew these to

BLOCH 175 B3 SPECIFICATION

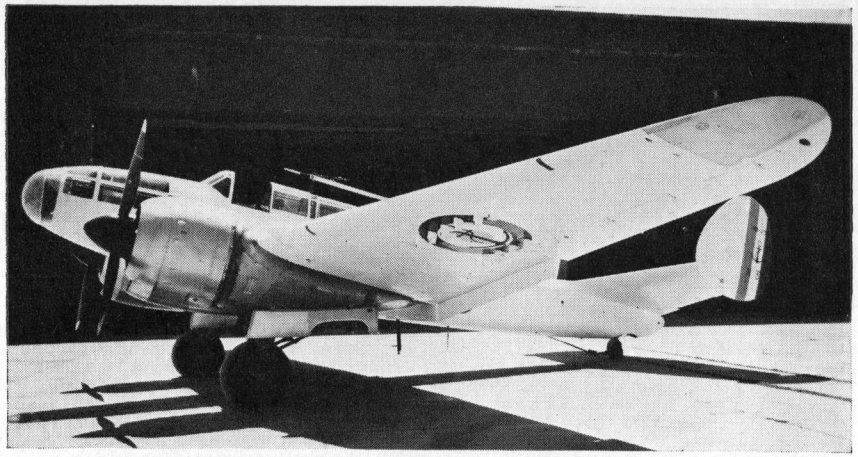
Type: *Three-seat Light Bomber and Attack Aircraft.* **Power Plants:** *Two Gnôme-Rhône* 14*N* 48/49 14-*cylinder radial air-cooled engines each rated at* 1,140 *h.p. for take-off and* 1,035 *h.p. at* 15,730 *ft.* **Armament:** *Two fixed forward-firing* 7.5-*mm. MAC* 1934 *M*39 *machine guns with* 1,000 *r.p.g., two* 7.5-*mm. MAC* 1934 *machine guns with eight* 100-*round drums on flexible SAMM-AB*68 *dorsal mounting, and three* 7.5-*mm. MAC* 1934 *M*39 *machine guns with* 500 *r.p.g. firing aft from ventral wobble-mounts.* (*Offensive*) *Three* 441-*lb., four* 220-*lb., eight* 110-*lb., or* 32 22-*lb. bombs.* **Performance:** *Maximum speed,* 248 *m.p.h. at sea level,* 335 *m.p.h. at* 17,060 *ft.; maximum cruising speed,* 285 *m.p.h. at* 13,120 *ft.; economical cruising speed,* 244 *m.p.h. at* 13,120 *ft.; range at* 85 *per cent power with* 1,323-*lb. bomb load,* 993 *mls.; ferry range,* 2,050 *mls.; time to* 26,250 *ft.,* 13.5 *min.* **Weights:** *Empty,* 12,478 *lb.; normal loaded,* 17,170 *lb.; maximum,* 17,688 *lb.* **Dimensions:** *Span,* 58 *ft.* 11 *in.; length,* 40 *ft.* 9½ *in.; height,* 11 *ft.* 7¾ *in.; wing area,* 413.289 *sq. ft.*

Déols, removed the engines and sent them back to Mérignac by road for installation in another three airframes. As a result of this procedure, the rate of transfer was only about three aircraft per month, and when German forces entered the Unoccupied Zone in November 1942, terminating the operation, only nine airframes had arrived at Déols.

For several months the Déols plant studied and produced a wooden mock-up of a modified version dubbed **Bloch 175A** which could carry either two 1,102-lb. bombs internally or one 2,535-lb. torpedo externally. The adaptation of the Bloch 175 as a heavy fighter was also studied as a potential replacement for the Potez 631. Designated **Bloch 175B**, the fighter was intended to have a redesigned nose housing a battery of four 20-mm. Hispano-Suiza 404 cannon and four 7.5-mm. MAC 1934 M39 machine guns. The standard Bloch 175 rear-firing armament was to have been retained, only two crew members were to have been carried, and power was to have been provided by two turbo-supercharged fuel-injection Hispano-Suiza 12Z engines rated at 1,300 h.p. at 26,240 ft. Earlier the HS 12Y with Brown-Boveri turbo-superchargers had been the intended power plant of a high-altitude bomber development, the **Bloch 178**, which was under construction at Courbevoie in 1940 and stopped by the arrival of the German forces.

External racks for 551-lb. and 1,102-lb. bombs were manufactured for Bloch 174s and 175s at Déols and shipped to North Africa, and dive brakes were designed and experimentally fitted to Bloch 175 No. 102 which, drawn from the *Base de Stockage de Perpignan*, was flown with these on November 18, 1942, but further development of the Bloch 175 was stopped by the arrival of German forces in the Unoccupied Zone, and was only resumed after the liberation.

The *Aéronavale* had first begun to evince interest in the Bloch 175 in 1940, and an aircraft of this type had been fitted with a torpedo rack and evaluated at Tafaraoui in the summer of 1941. This interest was maintained, and in 1945 an order was placed on behalf of the *Aéronavale* for 100 **Bloch 175Ts** (the "T" suffix indicating *Torpillage*). The rear fuselages were to be produced at Bouguenais, the ailerons and tail assemblies at Saint Nazaire,



The Bloch 175T No. 32, one of eighty examples built for France's Aéronavale. This machine was the second to feature the revised and enlarged vertical tail surfaces first tested by Bloch 174 No. 53

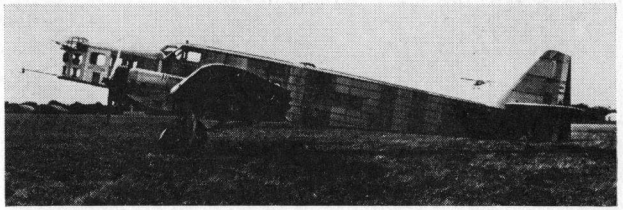
and the outer wing panels at Rochefort, final assembly being undertaken at Châteauroux-Déols.

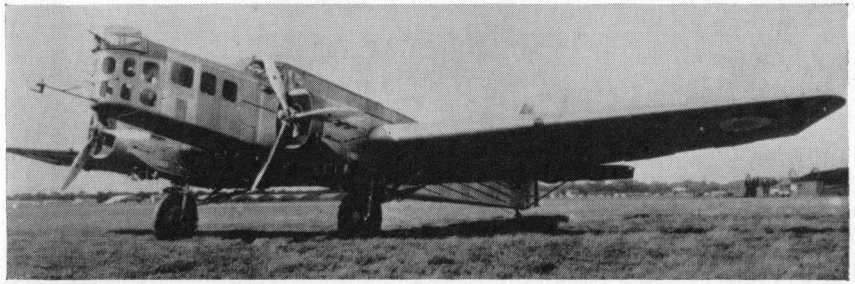
Flown on May 15, 1946, the Bloch 175T No. 1 was externally similar to the 1940 version, and No. 31 and subsequent machines had the revised and enlarged tail fins first tested on Bloch 174 No. 53. Deliveries to the *Aéronavale* began during October 1946 when *Flottille* 6F began converting to this type from the Ventura. Armament comprised two wing-mounted 20-mm. Mauser MG 151 cannon and a similar weapon on a SAMM-AB201 dorsal mounting, eight 90-mm. rockets, and one 1,654-lb. torpedo on an LBT 130 Alkan rack or three 330-lb. Mk.47 depth charges on a SADEA rack. British Mk.XII radar was installed, and during the production run the Gnôme-Rhône 14N 54/55 engines rated at 1,150 h.p. for take-off and 900 h.p. at 4,920 ft. were supplanted by GR 14N 66/67 and 70/71 engines which offered the same normal rated output at 8,860 ft. Budgetary factors resulted in the initial production order being cut back to 80 aircraft, and production of the Bloch 175 finally terminated in 1950, almost 11 years to the month since the first prototype had flown at Villacoublay.

BLOCH 210 FRANCE

The Bloch 210 is perhaps most noteworthy for having marked the transitional stage in French medium bomber design from the braced high-wing monoplane with fixed undercarriage to the cantilever low-wing monoplane with retractable undercarriage. A sturdy, docile, but matronly and uninspired creation, it bore a close relationship to its immediate predecessor, the Bloch 200; the shoulder-mounted wing and immense trousered undercarriage giving place to a low-positioned wing and mainwheels that lifted forward into the engine nacelles as concessions to modernity. It retained all the angularity so characteristic of French bomber design of the late 'twenties and early 'thirties, however, and its ponderous, slab-sided fuselage, with extensively-glazed rectangular nose surmounted by a birdcage-like turret offered little advance over that of the older warplane, although, admittedly, fineness ratio had been improved, the raised cabin roof had been suppressed, and the dorsal and ventral turrets could be retracted, the result being markedly less offensive aesthetically if

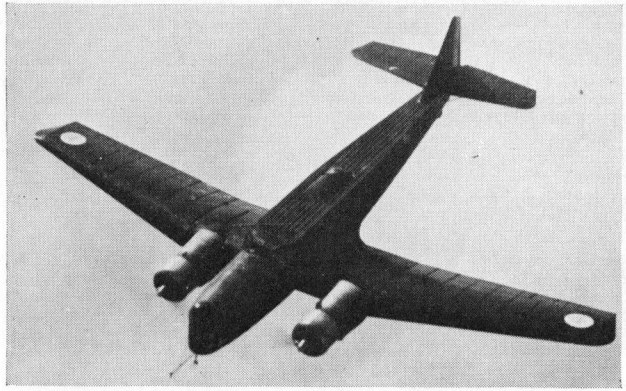
(Right and below) The Bloch 211 BN4 No. 1 which differed from the Bloch 210 primarily in the type of power plants installed

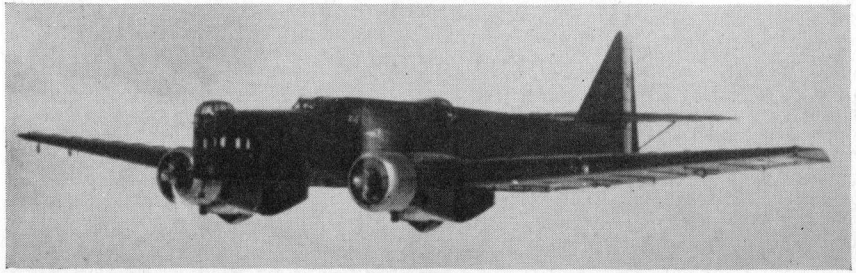




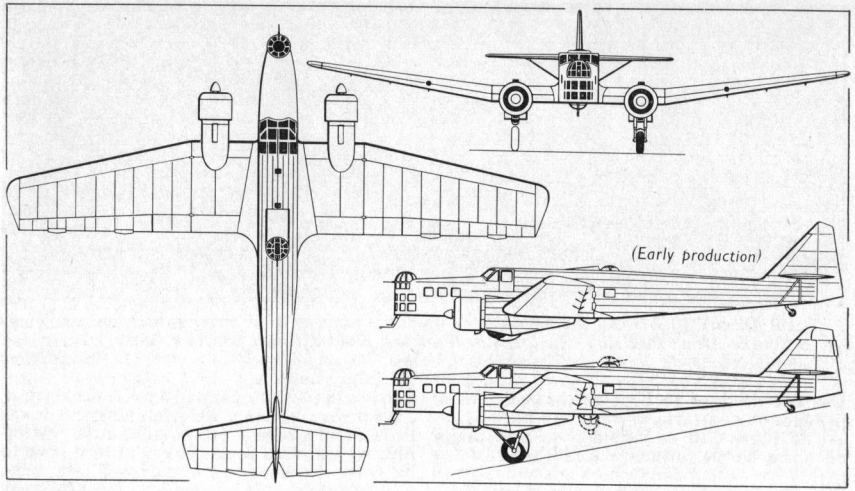
not a classic example of aerodynamic drag reduction.

Designed as a private venture by Avions Marcel Bloch in 1933 to fulfil both night bombing and torpedo-bombing roles, the **Bloch 210** prototype was built at Courbevoie, and flown for the first time at Villacoublay on November 23, 1934 with two Gnôme-Rhône 14Kdrs/grs Mistral-Major radials each offering 800 h.p. at 12,630 ft. A second prototype, the **Bloch 211 Verdun** with 860 h.p. Hispano-Suiza 12Y liquid-cooled engines with frontal-type radiators, had been built simultaneously, this being exhibited at the *Salon de l'Aéronautique* in Paris in November 1934. Apart from the power plants and the undecarriages (that of the Bloch 210 being fixed and that of the Bloch 211 being retractable), the two aircraft were similar, the wing being a two-spar



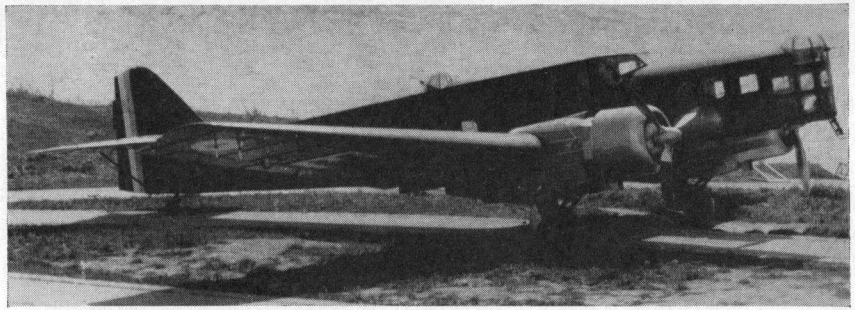


(*Left and below*) *An early production Bloch* 210 *with the taller vertical tail surfaces that characterized the initial aircraft*



structure comprising two parallel-chord centre-section components attaching to the fuselage main-frames, and two tapered outer panels, the whole covered by light metal panels externally reinforced with "U" stringers, and the fuselage being a rectangular-section structure also covered by metal panels and reinforced externally. Total fuel capacity was 658 Imp. gal. divided between two 66 Imp. gal. tanks in the engine nacelles, and two 141 and two 122 Imp. gal. tanks between the centre-section main spars, and provision was made for four crew members.

Initial trials of the Bloch 210 revealed the need to extend the tailplane, this modification being undertaken in December 1934, the position of the dorsal turret being moved forward simultaneously. Trials were resumed on January 15, 1935, but before the first CEMA (*Centre d' Essais du Matériel Aerien*) flight test took place a month later, on February 14th, additional sweepback was applied to the wing outer panels and the retractable ventral turret had been installed. By April it was being flown at its maximum loaded weight of 18,740 lb., and in May armament was installed for trials at Cazaux which commenced on the 13th of that month. Meanwhile, the Bloch 211 had been modified in the light of trials with the Bloch 210, and, on August 29, 1935, flew for the first time at Villacoublay, commencing CEMA trials in mid-September, although this variant



A Bloch 210 *BN5 at the SNCASE's Vitrolles plant in* 1937 *prior to acceptance by the Armée de l'Air. The last Vitrolles-built Bloch* 210 *was flown on January* 19, 1938

was not destined to become the recipient of production contracts.

The Bloch 210 undoubtedly offered major advances in performance and load-carrying ability over the medium bombers available to the *Armée de l'Air*, and during September–October, 1935 production contracts were not only awarded Bloch but also the Potez-CAMS and Hanriot companies, the initial contracts calling for 80 machines of which Bloch and Potez were each to manufacture 25, the remaining 30 being the responsibility of Hanriot. The first production machine, the **Bloch 210 BN4 No. 1**, was produced by the parent company, and flown on December 12, 1935. It differed from the prototype primarily in having a retractable undercarriage and Gnôme-Rhône 14Kirs/jrs engines with a maximum output of 900 h.p. at 13,820 ft. and a normal rating of 870 h.p. at 10,550 ft., these being carried by deeper, flat-sided nacelles. Defensive armament comprised a single 7.5-mm. MAC 1934 machine gun in a manually-operated Type A nose turret, a similar weapon in a retractable Type B dorsal turret, and a third 7.5-mm. gun in the retractable ventral *Modele* 1935 "egg" turret. Up to 3,527 lb. of bombs could be carried internally, a typical maximum load comprising 128 22-lb. or 32 110-lb. bombs on Type D racks divided by a central catwalk, or a pair of 1,102-lb. bombs hung on TGPU 1929 racks beneath the catwalk floor.

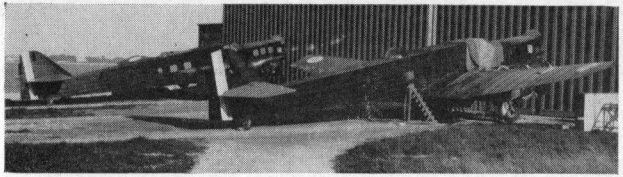
The second production aircraft, which began CEMA trials in April 1936, featured increased dihedral on the outboard wing panels, a modification subsequently adopted as standard, and during the course of 1936 supplementary production contracts for the Bloch 210 were placed with five manufacturers, 35 being ordered from Renault, a further 10 from Potez-CAMS, 20 more from Hanriot, 20 from the ANF Les Mureaux, and 16 from Breguet, bringing *Armée de l'Air* orders to 181 machines. The first Hanriot-manufactured

machine was flown at Bourges in November 1936, this being **Bloch 210 BN5 No. 51**—all aircraft of this type having been allocated the "BN5" (*Bombardement de Nuit—Cinq-Place*) from designation the previous March, this signifying an increase in the crew complement to five members. As a result of nationalization, the Vitrolles plant of Potez-CAMS became a part of the SNCASE on February 1, 1937, the new organisation taking over the existing order for 10 additional Bloch 210s, the first of which, Bloch 210 BN5 No. 106, made its initial flight at Marignane on May 3, 1937, the last of the batch being flown on January 19, 1938. Breguet's Bouguenais plant had been allocated to the SNCAO, and the first of the 16 machines built at this factory, Bloch 210 BN5 No. 171, was completed in November 1937. Further contracts awarded in 1937 to the SNCASO, the SNCAO, and the SNCAC raised total orders to 257, the last of these, the SNCAC-built Bloch 210 BN5 No. 257, flying on March 19, 1939 at Bourges. Of these, 253 were destined to be delivered to the *Armée de l'Air*, and a further 24 were built against an order from the Rumanian government, the first three of these being delivered from Etampes on June 4, 1937 and deliveries continuing until mid-summer 1938.

Although an extremely sturdy aircraft without vices, the Bloch 210 proved to be somewhat underpowered, and several aircraft crashed during take-off as a result of their Gnôme-Rhône 14K engines over-heating and seizing. All *Armée de l'Air* units operating the Bloch 210 were therefore grounded pending re-engining with the Gnôme-Rhône 14N 10/11 which featured increased cylinder cooling area and offered 910 h.p. for take-off and 950 h.p. at 12,170 ft. These engines were first tested in the first and third production Bloch 210s during the summer of 1937. One of the Bloch-built examples had been fitted with Hispano-Suiza 14HA radials in July 1936, although it had not flown with these, and one of the Renault-built examples, Bloch 210 BN5 No. 87, was fitted with experimental 1,000 h.p. Renault 14T 2/3 radials and flown at Villacoublay in December 1937. The Bloch 210 prototype had, in the meantime, been flown to Marignane where it had been fitted with twin floats and flight tested from the Berre lake. On February 26, 1936 it had been delivered to Saint-Raphaël for *Aéronavale* trials as a torpedo floatplane. It was considered to possess insufficient range to warrant a production order, but was, nevertheless, still undergoing torpedo-dropping tests at Saint-Raphaël in November 1939.

OPERATIONAL CAREER

At the beginning of World War II, the 11e, 12e, 19e, 21e, 23e, and 51e *Escadres de Bombardement* were operating the Bloch 210, each comprising two *Groupes* with a strength of 13–16 machines. However, although the installation of Gnôme-Rhône 14N 10/11 engines had resulted in an extremely reliable aircraft, the Bloch 210 was considered obsolescent, and only a few nocturnal reconnaissance sorties were flown by units equipped with this type before their withdrawal from operational stations for conversion to later types. The 12e Escadre had begun conversion to the LeO 451 in late September 1939, the 11e and 23e Escadres following suit in February 1940; the 51e Escadre had converted to the Potez 633 in January 1940 in preparation for the Bre 691 and 693; the 21e Escadre began conversion to the Amiot 351 and 354 in April 1940, and during the same month the 19e Escadre began conversion to the Douglas DB7. The Bloch 210s were progressively handed over by these units to OTUs such as the *Centre d'Instruction de Bombardement* at Toulouse-Francazals, although GB I/21 and II/21 (the *Escadres de Bombardement* having been



Bloch 210 *Nos.* 107 (*background*) *and* 108 (*foreground*) *at Vitrolles in the summer of* 1937

divided into autonomous *Groupes* from April 15, 1940, the 21e *Escadre* having become GB I/21 and II/21) still had a number of Bloch 210s on strength alongside their newly-delivered Amiot 351s and 354s when, on May 16th, they were hurried into battle. The Bloch 210s made a number of night attacks on targets in the Rhineland, Belgium and France, and before being ordered to North Africa on June 17th, GB I/21 and II/21 lost five Bloch 210s to flak and fighters, two had crashed in bad weather, and three were lost as a result of *Luftwaffe* bombing attacks. Nine others had been so badly damaged by flak that they had to be struck off after regaining their bases.

GB I/21 and II/21 were disbanded in the summer of 1940, and, depending on their condition, the remaining Bloch 210s were either stored or scrapped. Half a dozen were refurbished in 1942 and passed to the *Ecole de l'Air* at Salon-de-Provence for use as navigational trainers. A total of 37 Bloch 210s found in the Unoccupied Zone of France in November 1942 was seized by the German authorities and, allegedly, passed to the Bulgarian Air Force, although it is improbable that these were subsequently employed operationally.

BLOCH 210 BN5 SPECIFICATION

Type: *Five-seat Medium Night Bomber.* **Power Plants:** *Two Gnôme-Rhône* 14*N* 10/11 14-*cylinder radial air-cooled engines each rated at* 910 *h.p. for take-off and* 950 *h.p. at* 12,170 *ft.* **Armament:** (*Defensive*) *One* 7.5-*mm. MAC* 1934 *machine gun with* 800 *rounds in Type A manually-operated nose turret, one* 7.5-*mm. MAC* 1934 *machine gun with* 800 *rounds in Type B manually-operated retractable dorsal turret, and one* 7.5-*mm. MAC machine gun with* 800 *rounds in Modèle* 1935 *retractable ventral turret.* (*Offensive*) *Maximum of* 3,527 *lb. of bombs in various combinations of eight* 441-*lb.*, 32 110-*lb.*, *two* 1,102-*lb.*, *or* 128 22-*lb. bombs, plus four Michelin VM*3 *or Modèle* 1933 *flares on underwing racks.* **Performance:** *Maximum speed* (*at* 21,385 *lb.*), 200 *m.p.h. at* 11,480 *ft.; maximum cruising speed,* 171 *m.p.h. at* 13,120 *ft.; economical cruising speed,* 149 *m.p.h. at* 11,480 *ft.; maximum range,* 1,056 *mls.; range with* 3,086-*lb. bomb load,* 808 *mls.; climb to* 13,120 *ft.,* 12 *min.; service ceiling,* 32,480 *ft.* **Weights:** *Empty,* 14,109 *lb.; loaded,* 21,385 *lb.; maximum,* 22,487 *lb.* **Dimensions:** *Span,* 74 *ft.* 10 *in.; length,* 61 *ft.* 9 *in.; height,* 21 *ft.* 11¾ *in.; wing area,* 672.744 *sq. ft.*

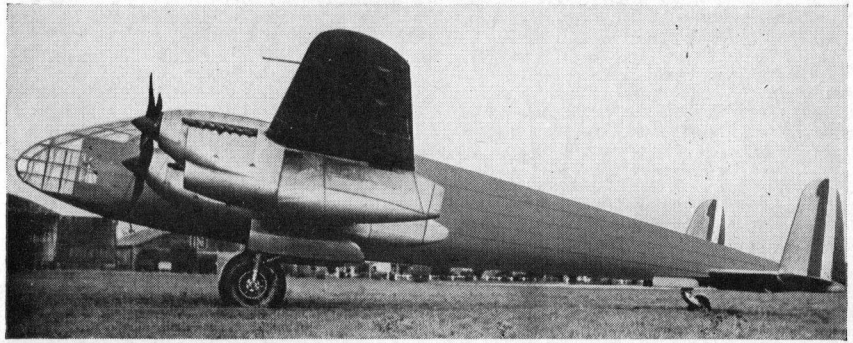
BREGUET 482 FRANCE

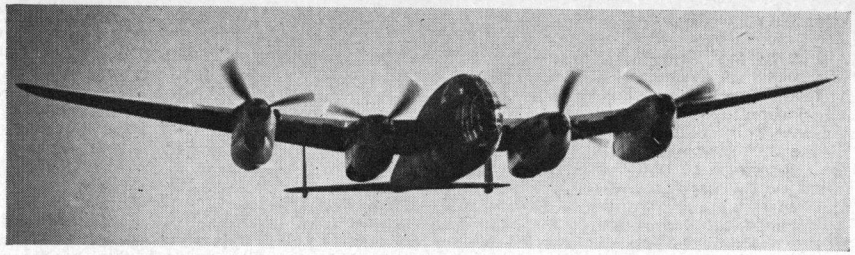
Although the *Programme Technique* A21, first issued on December 17, 1936, called for a twin-engined B4 (*Bombardement quadriplace*) aircraft powered by either the 1,225 h.p. Gnôme-Rhône 18L or the 1,500 h.p. Gnôme-Rhône 18P air-cooled radials, it resulted in the appearance of two *four*-engined medium bombers, the previously-described Bloch 135 and the rather more ambitious Breguet 482.

Breguet's initial proposal to meet the A21 requirement, the **Bre 480**, was intended to carry a 2,205-lb. bomb load over 50 per cent of a 1,566-mile range on the power of two Gnôme-Rhône 18L engines, but at an early stage the Gnôme-Rhône concern shelved development of the GR 18L and 18P engines in order to concentrate on the improvement of the lower-powered 14M and 14N radials, and the longer-term development of the 1,400 h.p. GR 14R and 2,000 h.p. GR 18R. It was obvious that neither the GR 14R or 18R would be available to meet the Bre 480 time-scale, and, in consequence, the Breguet design team was forced to consider alternative power plants to the Gnôme-Rhône radials.

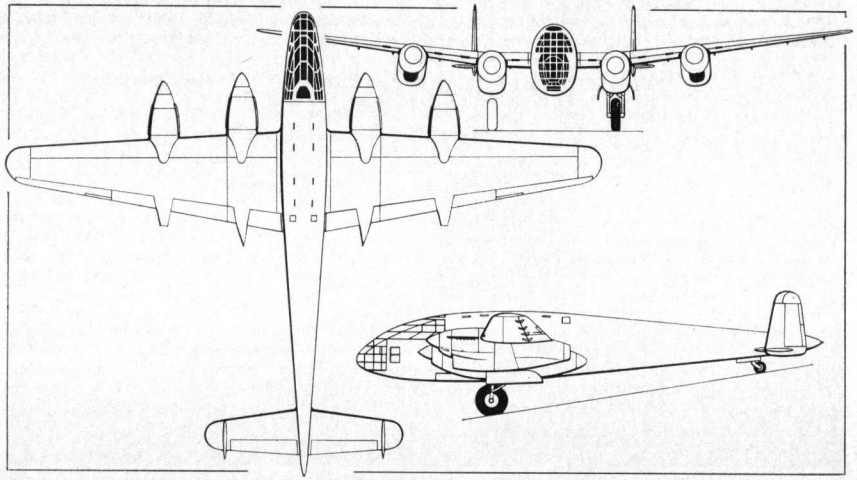
In the meantime, a further project, the **Bre 481** powered by two Hispano-Suiza 12Ydrs 2 engines rated at 992 h.p. for take-off and 920 h.p. at 2,590 ft., had been proposed. The **Bre 481 B4** was aimed at meeting the modified requirements of the 1937 *édition* of A21, and apart from the engine change, featured a reduction in gross wing area from 699.653 to 602.778 sq. ft. A parallel project to the Bre 481 B4 was the Bre 481 *Raid* which, with a further reduction in gross wing area to 484.376

The sole example of the Breguet 482 *to be completed, this, the second prototype, serving as a research aircraft during the late 'forties*





The Breguet 482 *B*4 *No.* 02 *was stored at Breguet's Anglet Plant near Bayonne throughout the Occupation, and was eventually flown at Toulouse in* 1947



sq. ft., was intended for long-distance record flights, but both proposals were abandoned in favour of the Bre 482 B4 which was essentially a four-engined derivative of the original Bre 480 project.

It was proposed that the **Bre 482 B4** should be powered by four Hispano-Suiza 12Y 21 engines each rated at 890 h.p. for take-off and 910 h.p. at 11,800 ft., and should feature a slightly enlarged wing, gross wing area being increased to 721.2 sq. ft., and wing span being increased from 78 ft. 8¾ in. to 79 ft. 4¾ in. Inner engine nacelles were to house the main undercarriage members and the outer nacelles the coolant radiators for both inboard and outboard power plants. This proposal was accepted by the *Service Technique* and, on May 12, 1938, the *Ministère de l'Air* ordered two prototypes of the Bre 482 B4.

Actual construction of the prototypes did not begin until a year after the placing of the contract with the Breguet plant at Vélizy-Villacoublay, by which time it had been agreed that the Hispano-Suiza 12Y 21 engines should be supplanted by HS 12Y 51 engines offering 1,100 h.p. both for take-off and at 10,695 ft. The Bre 482 was an exceptionally clean aircraft, with an oval-section all-metal monocoque fuselage. The stub wing centre section was built integral with the fuselage and carried the inboard engines nacelles, and this, like the outer panels, comprised a two-spar torsion box, an auxiliary rear spar, and stressed skinning. All fuel was housed between the fuselage and inboard engine nacelles and between inboard and outboard nacelles, normal fuel capacity being 693 Imp. gal. By reducing the bomb load from 5,512 to 4,189 lb., an auxiliary fuel tank of 253 Imp. gal. capacity could be housed in the fuselage. Defensive armament comprised a 20-mm. Hispano-Suiza 404 cannon on a power-operated dorsal mounting with 180 rounds, a single 7.5-mm. machine gun on a flexible mounting in the extreme nose with 500 rounds, and two similar weapons on separate flexible ventral mountings with 600 r.p.g.

The Bre 482 Nos. 01 and 02 were nearing completion at Villacoublay when, late in May 1940, it was decided to evacuate both airframes, the Bre 482 No. 01 being transported to the East Algerian coastal town of Bône, and the Bre 482 No. 02 being sent to the Breguet plant at Anglet, near Bayonne. The Anglet plant was subsequently occupied by German forces, but the second prototype remained undisturbed. The first prototype that had been sent to Algeria was not so fortunate as, during a *Luftwaffe* attack on Bône following the *Torch* landings, a stray bomb damaged the airframe beyond repair.

During the occupation, the Breguet design bureau had continued some design development of the basic aircraft, evolving the Br 482.24Z* project in 1943. Employing the basic Bre 482 B4 bomber airframe, the **Br 482.24Z** was to have been powered by two 2,500 h.p. Hispano-Suiza 24Z 24-cylinder liquid-cooled engines driving contra-props, and the rear fuselage was to have been redesigned to permit the installation of a power-operated SAMM-AB81 tail turret housing for 7.5-mm. MAC 1934 M39 machine guns. The project progressed no further than the design study stage, but immediately German forces withdrew, Breguet resumed development of the basic design. It was proposed that the Hispano-Suiza 12Y 51 engines be supplanted by HS 12Z engines rated at 1,500 h.p. for take-off and 1,350 h.p. at 8,200 ft., an additional 7.5-mm. machine gun should be mounted in the nose and the dorsal cannon supplemented by a pair

* *It should be noted that prior to* 1942 *the abbreviation "Bre" was used in designating Breguet aircraft, but subsequently this was reduced to "Br".*

of 7.5-mm. guns, and that the tail assembly, ailerons and flaps should be reinforced, these changes increasing maximum loaded weight from 35,366 lb. to 39,683 lb.

Work was begun in adapting the original Bre 482 No. 02, but for budgetary reasons, the French government elected to dispense with the *Armée de l'Air's* bombing component, converting all Halifaxes and Marauders for the transport role, and thus no further interest was displayed in this pre-war design for the bombing role. Nevertheless, with the exception of the modifications to the armament installations, it was decided to complete the reconstruction of the surviving prototype as a research aircraft, and this was eventually to fly for the first time (as F-WFRM) at Toulouse in November 1947. As a research aircraft all armament was removed, an SMG undercarriage of the type fitted to the SE-161 Languedoc transport was introduced, crew accommodation was revised to provide for a pilot, radio-operator and flight engineer, and redesign of the wingtips reduced overall span from 79 ft. 4¾ in. to 79 ft. 0¼ in. The aircraft was subsequently employed for various experimental purposes, including Hispano-Suiza 12Z development.

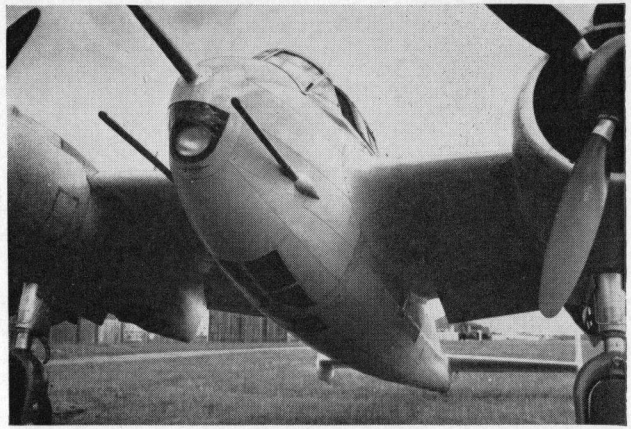
BREGUET 482 SPECIFICATION

(This specification applies to the Bre 482 B4 and is based on the manufacturer's estimates, figures in parentheses applying to the aircraft in the form in which it was eventually flown.) **Type:** *Four-seat Medium Bomber (Three-seat Research Aircraft).* **Power Plants:** *Four Hispano-Suiza* 12*Y* 51 (12*Z*) 12-*cylinder liquid-cooled engines each rated at* 1,100 (1,500) *h.p. for take-off and* 1,100 (1,350) *h.p. at* 10,695 (8,200) *ft.* **Armament:** *One* 7.5-*mm. MAC* 1934 *machine gun with* 500 *rounds on flexible mounting in nose, one* 20-*mm. Hispano-Suiza* 404 *cannon on power-operated dorsal mounting with* 180 *rounds, and two* 7.5-*mm. MAC* 1934 *machine guns on separate flexible ventral mountings with* 600 *r.p.g.* (*Offensive*) *Maximum of* 5,512 *lb. bombs* (*with* 693 *Imp. gal. fuel*), *typical proposed load being one* 1,102-*lb. bomb and* 10 441-*lb. bombs, or up to* 4,189 *lb. bombs* (*with* 946 *Imp. gal.*) *in various combinations of* 1,102-*lb. and* 441-*lb. bombs.* **Performance:** *Maximum speed,* 326 (363) *m.p.h. at* 13,120 (26,250) *ft.; cruising speed,* 248 (329) *m.p.h. at* 13,120 (26,250) *ft.; range,* (994) *mls.; service ceiling,* (39,370) *ft.* **Weights:** *Empty,* 20,876 *lb.; maximum loaded,* 35,366 (31,967) *lb.* **Dimensions:** *Span,* 79 *ft.* 4¾ *in.* (79 *ft.* 0¼ *in.*); *length,* 61 *ft.* 0¾ *in.* (61 *ft.* 10¾ *in.*); *wing area,* 727.639 (725.486) *sq. ft.*

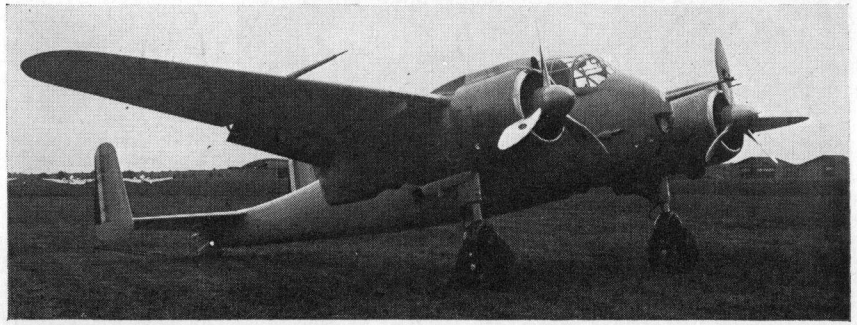
BREGUET 690 SERIES — FRANCE

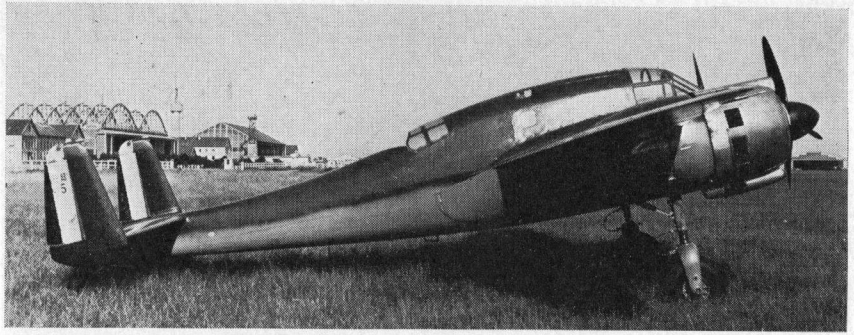
During the mid-'thirties a resurgence of interest in the potentialities of the twin-engined two- or three-seat fighter began to manifest itself on the European continent. Such warplanes had received sporadic attention previously, but as the primary task then envisaged for the fighter, that of day interception, could be most effectively fulfilled by less expensive single-engined single-seaters, little real effort had been placed behind the development of the longer-ranging, heavier combat aircraft. However, the history of military aviation is punctuated with developments initiated both simultaneously and

spontaneously in several countries, and the heavy twin-engined fighter monoplane with multi-purpose capabilities is a case in point, for the year 1934 saw work commence in Augsburg on what was to become the Messerschmitt Bf 110 and in Amsterdam on the design that was to emerge as the Fokker G.I, while in France, in October of that year, the *Service Technique de l'Aéronautique* issued a specification calling for

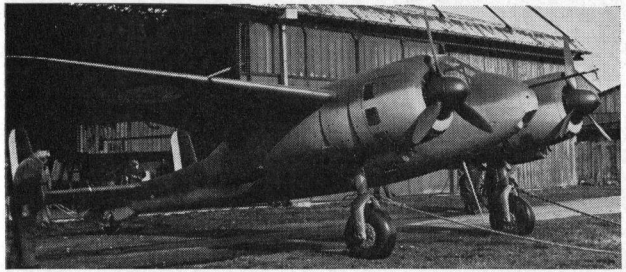


(*Right and below*) *The Bre* 690 *No.* 01. *This aircraft was built to a* Triplace de Chasse *specification but by the time it was flown the basic design was already being adapted for the attack role*





(*Below*) *The Bre* 691 *AB*2 *No.* 1 *at Villacoublay in May* 1939, *and* (*above*) *the Bre* 691 *AB*2 *No.* 5 *before delivery to Orléans-Bricy in October* 1939

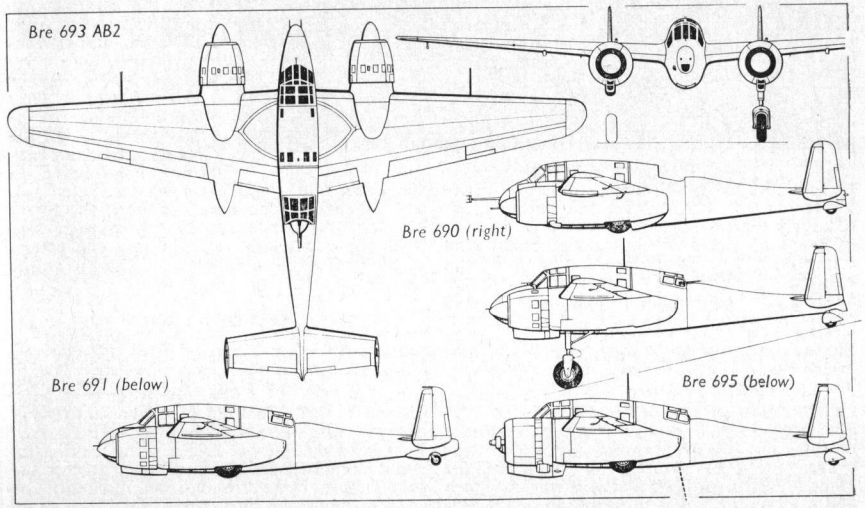


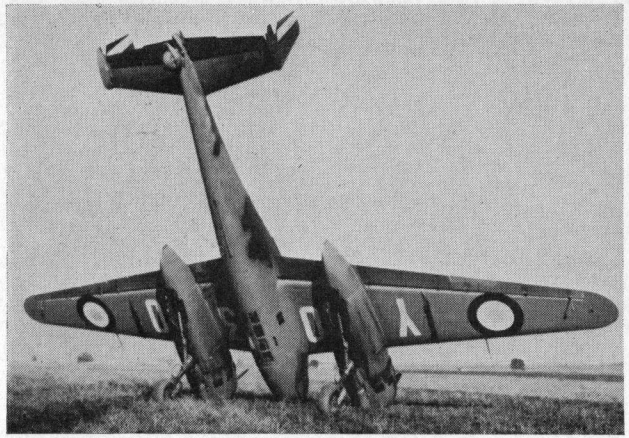
Specification C3 (indicating *Triplace de-Chasse* or Three-seat Fighter) led to the construction of the Potez 630, the Hanriot 220, the Loire-Nieuport 20 and the Romano 110, but perhaps the most advanced in conception of the contestants was the **Breguet 690** evolved by a team headed by Georges Ricard; a sturdy and aesthetically attractive warplane a three-seat fighter with a fixed forward-firing cannon armament suitable for intercept, escort and fighter director roles, and which set eight French design teams working along similar lines to those being pursued by contemporaries in Germany and the Netherlands. which, a number of years later, was to be referred to as a lightweight forerunner of the Beaufighter.

The Bre 690, characterised by an extremely short fuselage nose, was a mid-wing cantilever monoplane. The duralumin monocoque fuselage of oval section housed the pilot,

navigator and radio-operator gunner, twin 20-mm. Hispano-Suiza cannon being mounted in the fuselage, one on each side of the pilot's seat, and a single 7.5-mm. MAC 1934 was provided on a flexible mounting in the rear cockpit. The wing was also of all-metal construction, and comprised a torsion box with detachable leading and trailing edges and tips. Carrying metal-framed, fabric-covered ailerons and pneumatically-actuated flaps, the wing halves were bolted to the two fuselage mainframes which divided the three cockpits. The tailplane was of similar construction to the wing with fabric-covered movable surfaces. Power was provided by two Hispano-Suiza 14AB 02/03 14-cylinder air-cooled radials each rated at 680 h.p. at 11,480 ft and 650 h.p. for take-off, and driving opposite-rotating three-blade Hamilton airscrews, the 155 Imp. gal. fuel capacity being divided between two 45 Imp. gal. wing tanks and two 35.5 Imp. gal. tanks in the engine nacelles. The mainwheels retracted aft into the engine nacelles, and the long SMG legs resulted in a marked nose-up ground angle.

Construction of the Bre 690 was initiated at Villacoublay in 1935, but it was not until March 26, 1937, when nearly complete, that the prototype was officially ordered. In the meantime, the Potez 630 had been selected





A Bre 691 of the 54e Escadre after nosing-over at Vinon early in 1940

to fulfil the C3 requirement, and the *Service Technique* was toying with the potentialities of attack aircraft, although a serious division of opinion existed within the French air staff concerning such warplanes, a strong faction continuing to expound the theories of Douhet. While there now seemed little likelihood of an order for the Bre 690 as a fighter, its designer, Ricard, had borne in mind from the outset the possibility of his creation fulfilling alternative roles, and had already undertaken preliminary studies of a two-seat attack version. Construction of the Bre 690-01 was too far advanced for adaptation without seriously delaying the test programme, although, in the event, owing to priority in supply of the Hispano-Suiza engines being given to Potez 630 production, it was to be 10 months before a pair of these could be made available for installation in the Breguet prototype. In consequence, it was not until March 23, 1938 that Breguet's chief test pilot, Maurice Claisse, took the aircraft into the air for the first time.

The Bre 690-01 was delivered to the *Centre d'Essais du Matériel Aérien* (CEMA) four months later for official trials during which the prototype revealed superior performance to the Potez 630, good handling characteristics and excellent manoeuvrability, but the SMG oleo legs of the undercarriage proved to possess inadequate strength, necessitating the return of the prototype to Breguet for modifications late in August.

BREGUET 691

Even before delivery of the Bre 690-01 to the CEMA, the promise displayed by the prototype during factory tests had been such that, on June 14, 1938, an order had been placed for 100 examples of a two-seat attack bomber version, the **Bre 691 AB2** (*Assaut Bombardement—Deux-Place*), this quantity being increased to 204 machines during the following months, although the placing of the contracts met with bitter opposition from those

in the air staff still refusing to accept the need for attack aircraft.

Converting the basic design for its new role had presented no major problems, the principal change being the deletion of the navigator's cockpit between the two fuselage mainframes, its place being taken by a bomb rack housing eight 110-lb. bombs arranged one above another. Fixed forward-firing armament was reduced to one 20-mm. HS 404 cannon installed in the starboard side of the forward fuselage and aimed by the pilot with the aid of a Baille-Lemaire 40 gunsight which could also serve as a bomb-sight for diving attacks. The forward-firing cannon was supplemented by a pair of 7.5-mm. MAC 1934 machine guns, the pilot being able to deflect all three weapons – 15° for ground strafing, and a Facine 20 camera was also mounted in the nose. The radio operator-gunner in the aft cockpit was provided with a 7.5-mm. MAC 1934 machine gun on an Alkan 220 (later Alkan 224) flexible mounting for rear defence, and also a similar weapon fixed to fire rearward and downward at an oblique angle for strafing.

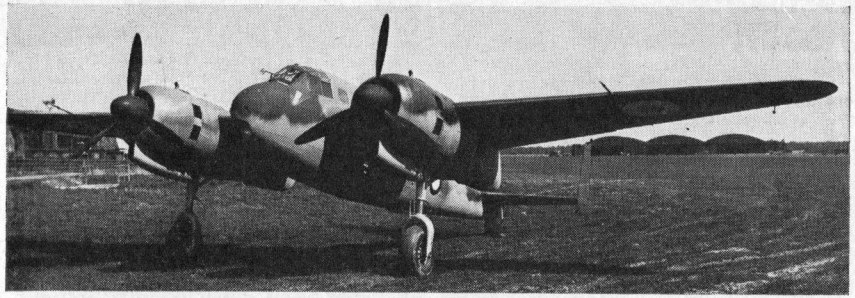
By comparison with the Bre 690-01, the Bre 691 featured a slightly increased overall length resulting from an 11.8-in. extension of the nose; the engine mounts were lengthened to carry the power plants 9.4 in. further forward to reinstate the c.g. to its original position; the stroke of the oleo legs of the main members and tailwheel was increased, the tailwheel itself being enlarged; the oil coolers were transferred from the wing leading edges to beneath the engine nacelles; the sliding canopy for the pilot was supplanted by outward-opening hinged sections, and total fuel capacity was increased to 217 Imp. gal. by the introduction of a supplementary 31 Imp. gal. fuel cell in each engine nacelle.

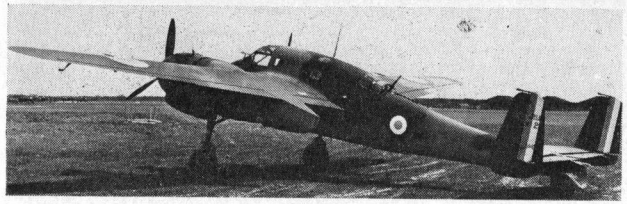
The first 100 Bre 691s were intended to receive Hispano-Suiza 14AB 10/11 engines offering 700 h.p. for take-off and 725 h.p. at 10,660 ft., subsequent aircraft being powered by HS 14AB 12/13 engines which, specifically intended for low-level operations, offered 800 h.p. for take-off and 745 h.p. at 2,130 ft. Whereas the first 50 aircraft were to receive Ratier 1447/1448 airscrews these were to be replaced by Hamilton HS 1311/1312 airscrews with the 51st machine.

Breguet established an assembly line for the Bre 691 with remarkable speed, and less than one year after the placing of the initial order the first production aircraft had rolled off the line and flown. In fact, the Bre 691 No. 1 flew less than eight weeks after the prototype of the attack model, the Bre 691-01, which, flown on March 22, 1939, was followed by the production machine on May 15th, and late in August *Escadrille* 1/54 had been detached from the 54e *Escadre* and transferred to Orléans-Bricy where, in October, an initial batch of five Bre 691s arrived.

BREGUET 693

The Hispano-Suiza 14AB engine had the advantages of small diameter and a relatively good ratio of power to frontal area, but it had soon been realised that this power plant was not living up to its early promise. Teething troubles had not been eliminated and reliability was low, and as Hispano-Suiza was devoting all its energies to the development of liquid-cooled engines, it was decided to supplant that company's air-cooled radial by the Gnôme-Rhône 14M engine of even smaller diameter. Thus, Bre 691 No. 19 was modified on the assembly line to take a pair of Gnôme-Rhône 14M 6/7 engines rated at 700 h.p. for take-off and 660 h.p. at 13,120 ft., flying for the first time on October 25, 1939 as the **Bre 693-01**. This aircraft was delivered to the CEMA for official tests on November 24th, and as it was ascertained that performance





(Above and left) The second production Bre 693 *AB*2 *at Villacoublay in March* 1940

with the new engines was virtually unchanged, instructions were given to Breguet to terminate Bre 691 production with the 78th aircraft and produce the 79th and subsequent aircraft as Gnôme-Rhône-powered Bre 693s. Accordingly, the 79th production airframe was flown on March 2, 1940 as the Bre 693 No. 1.

Apart from its Gnôme-Rhône engines, the Bre 693 was similar to the Bre 691 in equipment and armament, although late production machines introduced a single rear-firing MAC 1934 machine gun mounted at a negative angle in the tail of each engine nacelle, and a supplementary production order was placed in Belgium with the Société Anonyme Belge de Constructions Aéronautiques (SABCA) for an initial batch of nine Bre 693s for the *Armée de l'Air*. SABCA also began production of 32 **Bre 694s** for Belgium's *Aéronautique Militaire*, although, in the event the German occupation of Belgium prevented the completion of any of the Breguet aircraft by SABCA.

The Bre 694 was essentially a tactical reconnaissance variant of the Bre 693 carrying three crew members and possessing secondary attack capability, and development of this model was initiated during the summer of 1939 at the request of the Swedish government which subsequently placed an order for 12 aircraft. The Bre 694 was powered by two

Gnôme-Rhône 14M 4/5 engines rated at 710 h.p. for take-off and 680 h.p. at 13,200 ft., the central cockpit featured by the original Bre 690 was reinstated to accommodate the observer with his vertical camera, and armament was restricted to one fixed forward-firing machine gun and one machine gun on a flexible mount in the rear cockpit.

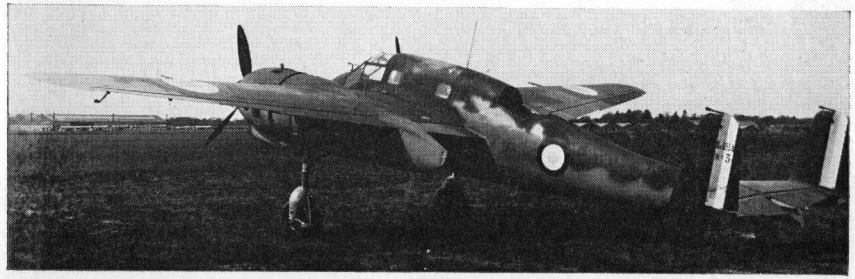
The Swedish order for the Bre 694 was cancelled, but Belgium's *Aéronautique Militaire* evinced interest in a slightly modified version with a heavier forward-firing armament and more readily adaptable for operation either as a three-seat reconnaissance aircraft or as a two-seat bomber. The prototype, the Bre 694-01, was flown for the first time at Villacoublay on January 20, 1940, and this sole example of its type was eventually delivered to France's *Aéronavale* on June 1, 1940. The *Aéronavale* had, incidentally, planned to order 100 Bre 693s for shore-based operations.

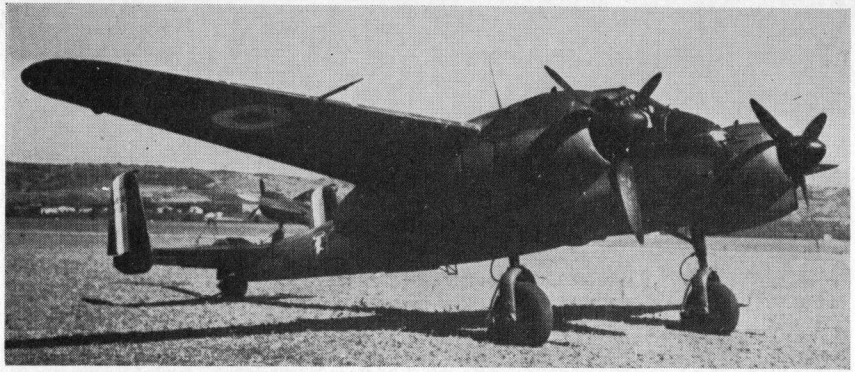
BREGUET 695

In 1939, the policy of adapting every production combat aircraft amenable for alternative U.S. or British engines as a safeguard against the destruction of French power plant manufacturing facilities had been officially adopted and, accordingly, the Bre 690-01 had been re-engined with a pair of Pratt & Whitney SB4G Twin Wasp Junior 14-cylinder two-row radials to serve as the prototype **Bre 695**. Rated at 825 h.p. for take-off and 750 h.p. at 9,000 ft., the Pratt & Whitney engine was lighter than the Gnôme-Rhône, but its overall diameter at 44.12 in. was almost 20 per cent greater than that of the French engine with its diameter of 37.4 in., and the poorer ratio of power to frontal area was further aggravated by the fact that the U.S. engine was unsuited for the low-drag, NACA-type cowling fitted to the Gnôme-Rhône.

The engine bearers had to be completely redesigned and extended in order to carry the lighter U.S. engines further forward of the wing leading edge to maintain the c.g., and the nacelles themselves had to be substantially redesigned. The considerably larger cowlings seriously restricted the pilot's vision to the side,

The Bre 693 *AB*2 *No.* 34 *at Villacoublay in April* 1940 *prior to delivery to GBA II*/54 *at Roye from where this unit initiated operations on May* 12, 1940





A Bre 693 *AB*2 *of the* 2e *Escadrille of GBA I*/51 *in the spring of* 1940, *this unit commencing operations in the Arras area from Etampes on May* 20, 1940

the increased drag reduced performance by some six per cent, and both take-off and landing characteristics left something to be desired, with the result that the Bre 695 was not to achieve the popularity in service with the *Armée de l'Air* enjoyed by the Bre 693.

A pre-production contract for 15 Bre 695 AB2s had been placed on July 27, 1939, this being substantially increased five weeks later, on September 2nd, and despite the previously-mentioned shortcomings, flight trials of the Bre 695-01 which commenced on March 3, 1940 were considered successful, and the Bre 695 No. 1 was flown on April 23, 1940 with deliveries to *Groupement* 18 commencing in the first week of June.

EXPERIMENTAL VARIANTS

The amenability of the basic design to adaptation for alternative roles and the obvious suitability of the clean and sturdy airframe for progressively more powerful engines resulted in a number of experimental models and proposals for several others, and at an early stage an investigation was made by Ricard of the possibility of installing Gnôme-Rhône 14N 14-cylinder two-row radials offering 980 h.p. at 14,850 ft., this project being designated **Bre 692 AB2**. Although a truly spectacular increase in performance could have been anticipated for the Bre 692, the 50.7-in. diameter of the GR 14N necessitated such extensive redesign that this model progressed no further than the drawing board.

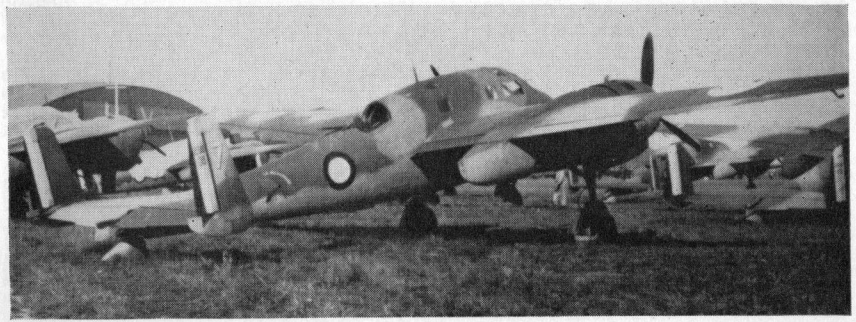
A change of role was envisaged with the **Bre 696 B2** (*Bombardement—Deux-Place*) which was essentially a two-seat light bomber derivative of the Bre 693 with similar power plants (i.e., Gnôme-Rhône 14M 6/7). The

Bre 696 embodied a slightly extended bomb-bay capable of accommodating four 220-lb. or two 441-lb. bombs superimposed one above the other, the bombardier-radio operator aiming these by means of a Bronzavia D 30 periscopic sight projecting beneath the floor of his cockpit. Fixed forward-firing armament was reduced to two 7.5-mm. MAC machine guns, and rear defence was provided by a single MAC 1934 machine gun on a flexible mount. The prototype, the Bre 696-01, was flown on November 3, 1939, and the Bourges (ex-Hanriot) plant of the Société Nationale de Constructions Aéronautiques du Centre (SNCAC) was ordered to tool up and produce the Bre 696 B2. However, the greater priority attached to attack aircraft resulted in the cancellation of Bre 696 production at Bourges in favour of the Bre 693 AB2, SNCAC-built aircraft commencing with No. 1001 in the spring of 1940.

Despite the abandoning of the Bre 692, Bre 691 No. 17 was fitted with two Gnôme-Rhône 14N 48/49 engines rated at 1,070 h.p. at 7,250 ft. as a pre-prototype for the similarly-powered **Bre 700 C2** two-seat heavy destroyer on Ricard's drawing boards in mid-1939. The re-engined aircraft, designated **Bre 697-01**, was flown for the first time on October 19, 1939 at Villacoublay, displaying a remarkable rate of climb and a maximum speed of 354 m.p.h. Two prototypes of the Bre 700 C2 were ordered on February 17, 1940, but only mock-ups of the project had been completed when the occupation terminated further work, and the Bre 697-01 was destroyed to prevent it falling into German hands. The Bre 700 C2's design was based on that of the Bre 690 series, but armament included a single fixed forward-firing 30-mm. cannon, and anticipated performance included a maximum speed of 373 m.p.h. at 13,120 ft.

A further project that failed to see fruition was the **Bre 698 Bp2** (*Bombardement en piqué*

Bre 693 *AB*2 *No.* 1013 *of the GBA II*/54 *at Toulouse-Francazales in June* 1940



—*Deux-Place*) two-seat dive bomber intended specifically to meet an *Armée de l'Air* requirement to which the Potez 63.13 was also developed. Similarly powered to the Bre 693, the Bre 698 Bp2 featured braking ailerons similar in principle to those evolved by Junkers, and this fact resulted, after the occupation, in Georges Ricard being interrogated by Gestapo and RLM officials who suspected that the device was the result of French espionage.

Yet another projected derivative of the basic design was the **Bre 699 B2** which was merely the Bre 696 re-engined with SB4G Twin Wasp Juniors, and like the Bre 698 Bp2, this variant proceeded no further than the drawing board.

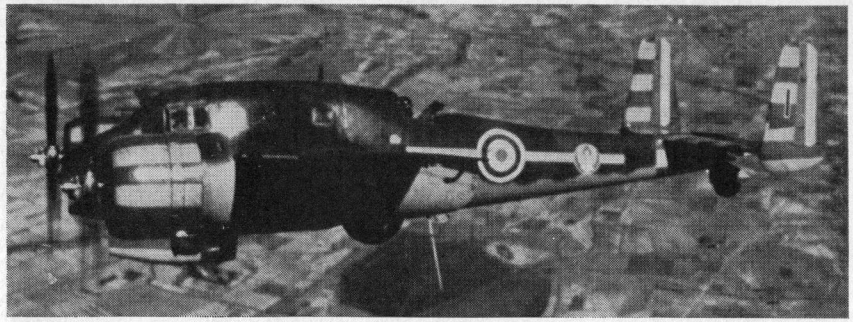
The final projected development of Georges Ricard's basic design was the Bre 810, a two-seat shipboard attack bomber for the *Aéronavale* answering the requirements of *Programme Technique A 82* of October 1939. The Bre 810's airframe was similar to that of the Bre 690 series, but the outboard wing panels were arranged to fold, and braking flaps and arrester gear were to have been fitted, the engines being Gnôme-Rhône 14M 4/5s.

OPERATIONAL CAREER

In October 1939, *Escadrille* 1/54 had begun conversion to the Bre 691, and in the following month the remaining two *escadrilles* of the 54e *Escadre* also began conversion, being transferred in December 1939 to form the 6e *Brigade de Bombardement d'Assaut* with the 51e *Escadre* which also began conversion to the Bre 691 in the following January. While the popularity of the aircraft with its aircrews was soon established, the poor reliability of the Hispano-Suiza engines did not endear it to the maintenance personnel, and undercarriage failures proved troublesome. On April 15, 1940, the 6e *Brigade* was disbanded, the 54e *Escadre* becoming *Groupement* 18 (comprising GBA I/54 and II/54), and the 51e *Escadre* becoming *Groupement* 19 (comprising GBA I/51 and II/51). Simultaneously, *Groupement* 18 took delivery of its first Bre 693, and on May 11th GBA I/54 was based at Montdidier with 14 Bre 693s, GBA II/54 being based at Roye with 12 Bre 693s.

GBA I/54 undertook its first operational sortie on the evening of May 12th when 11 of the unit's Bre 693s attacked German columns in the Tongeren area, encountering extremely heavy ground fire. Seven of the aircraft were shot down during this one operation; one was so severely damaged that it crash-landed at Bapaume; one was forced to land at Berry-au-Bac, and only two succeeded in returning to Montdidier, one of these being so badly damaged that it was not repairable. GBA II/54 which had performed a similar mission in the same area with seven Bre 693s enjoyed better fortune, however, losing only one aircraft.

At this time, *Groupement* 19 was still in the South of France completing conversion to the Bre 693, but the *Groupe de Bombardement* II/35, which, during the previous March had begun conversion to the Bre 691 at Briare, and had received its first three Bre 693s (from the SNCAC production line) a few days earlier, provided a reserve of aircraft and crews, and on May 16th, when the advancing *Panzer-divisionen* forced *Groupement* 18 to fall back on Briare, crews were transferred from GBA II/35 to replace casualties, and some reinforcement was provided by *Groupement* 19 which had been hurriedly transferred North and reached Etampes on May 19th. This unit had still not completed conversion to the Bre 693, six of the Potez 633s that had been employed in the conversion training role still being on strength, and several of these accompanied the Bre 693s on the first operational sortie to be flown by *Groupement* 19 on May 20th, a 14-

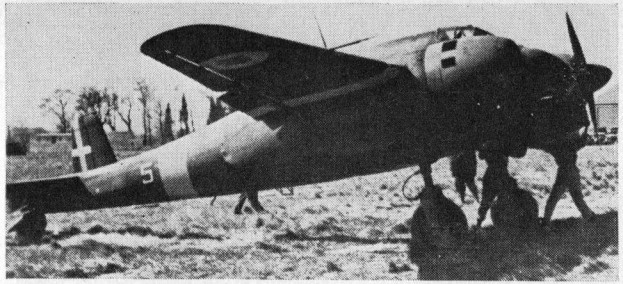


Bre 695 *AB2 of the* 1ere *Escadrille of GBA I*/51 *based at Lézignan in* 1942. *GBA I*/51, *together with GBA I*/54 *formed Groupement* 18 *in the Armée de l'Air*

aircraft strafing sortie in the Arras area. The Potez 633s were withdrawn two days later.

The Bre 693 enjoyed varying success during its sorties, losses proving negligible when the element of surprise was employed. After GBA I/54's disastrous sortie of May 12th, various tactics were tried, the most successful being a 45° diving attack from about 3,000 ft. with fighter top cover, but as the situation deteriorated fighter cover was rarely available for the attack aircraft, and although the prescribed altitude for bombing was 3,000 ft., bombs were usually dropped at about 1,000 ft. after a hedge-hopping approach. *Groupements* 18 and 19 maintained operational sorties until the ceasefire, retreating from airfield to airfield, and by June 25th had flown nearly 500 sorties during which 47 aircraft had been lost. The extremely sturdy construction of the Bre 693 enabled many aircraft to regain their bases despite extensive flak damage, and had it not been for the excellent maintenance features of this attack aircraft—a complete engine change could be effected in 1 hr. 20 min.—it would have been virtually impossible to maintain any operational strength during the successive airfield moves. The armament of the Bre 693 had proved extremely effective, but there can be little doubt that better results could have been obtained had the Gnôme-Rhône engines developed maximum power at low altitude rather than at 13,120 ft., the *Ministère de l'Air* having neglected, despite the low-altitude role of the Bre 693, to order a version of the GR 14M fulfilling low-flying requirements.

Production of the Bre 690 series stopped as German forces neared Villacoublay and, a few days later, Bourges, the Villacoublay plant having completed 224 Bre 693s and 50 Bre 695s of which no more than 106 and 33 respectively were actually delivered to the *Armée de l'Air* owing to delays in the delivery of various items of equipment. SNCAC production of the Bre 693 at Bourges totalled 30 aircraft, the 24th



A Bre 693 *after delivery to the Regia Aeronautica early in* 1943

of which (No.1024) having made its acceptance flight on June 9, 1940. Under the terms of the Armistice, GBA II/35, II/51 and II/54 were disbanded, but the Vichy government was authorised to maintain *Groupement* 18 (comprising GBA I/51 and I/54) with a total strength of 26 aircraft at Lézignan, this including a number of Bre 695s on the strength of GBA I/51. These were seized in November 1942 with the German occupation of the Vichy zone, and a number of them, together with several found in the *Bases de Stockage*, were transferred to Italy for use by the *Regia Aeronautica* as operational trainers.

BREGUET 691–693 AB2 SPECIFICATION

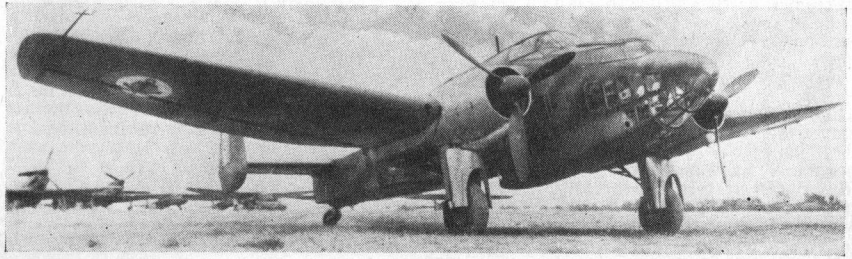
Type: (*Bre* 691 *and Bre* 693) *Two-seat Light Attack Bomber*. **Power Plants:** (*Bre* 691) *Two Hispano-Suiza* 14*AB* 10/11 14-*cylinder two-row radial air-cooled engines each rated at* 700 *h.p. for take-off and* 725 *h.p. at* 10,660 *ft., or* (*Bre* 693) *two Gnôme-Rhône* 14*M* 6/7 14-*cylinder two-row radial air-cooled engines each rated at* 700 *h.p. for take-off and* 660 *h.p. at* 13,120 *ft*. **Armament:** (*Bre* 691 *and Bre* 693) *Eight* 110-*lb. bombs internally and* (*fixed forward-firing*) *one* 20-*mm. HS* 404 *cannon with* 60 *rounds and two* 7.5-*mm. MAC* 1934 *machine guns with* 500 *r.p.g.*, (*fixed rear-firing at oblique angle*) *one* 7.5-*mm. MAC* 1934 *gun with* 500 *rounds, and* (*rear-firing on flexible mounting*) *one* 7.5-*mm. MAC* 1934 *gun fed by* 100-*round drums. Fixed rear-firing armament on late production Bre* 693 *supplemented by two additional* 7.5-*mm. MAC* 1934 *guns in rear of engine nacelles*. **Performance:** (*Figures relate to both Bre* 691 *and Bre* 693 *except those in parentheses which apply specifically to the latter*) *Maximum speed at* 9.920 *lb.*, 242 *m.p.h. at sea level*, 267 (265) *m.p.h. at* 6,560 *ft.*, 298 (295) *m.p.h. at* 13,120 *ft.*, 295 (304) *m.p.h. at* 16,400 *ft.; maximum speed at* 10,800 *lb.*, 227 *m.p.h. at sea level*, 295 (292) *m.p.h. at* 13,120 *ft.; maximum cruising speed*, 253 (248) *m.p.h. at* 13,120 *ft.; economical cruising speed*, 186 *m.p.h. at* 9,840–13,120 *ft.; maximum range at econ. cruise*, 840 *mls.; time to* 13,120 *ft.*, 7 (7.2) *min.* **Weights:** (*Bre* 693 *in parentheses*) *Empty*, 6,834 (6,636) *lb.; normal loaded*, 9,920 *lb.; maximum loaded*, 11,023 (10,800) *lb*. **Dimensions:** *Span*, 50 *ft.* 5 *in.; length*, 31 *ft.* 8¾ *in.; height*, 10 *ft.* 5¾ *in.; wing area*, 314.3 *sq. ft.*

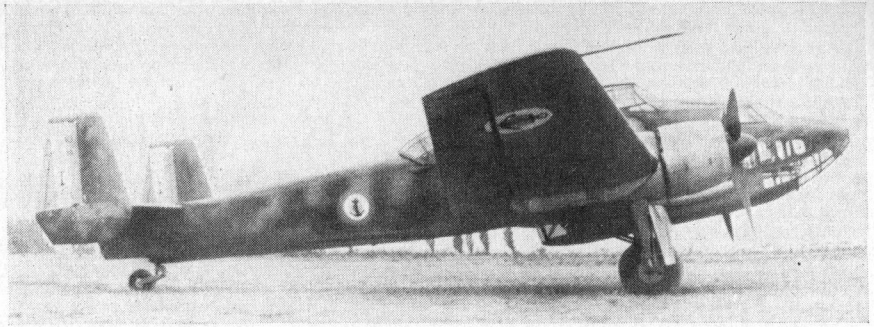
Aviation offers a continual conflict between the conventionalists and the visionaries, and in the immediate pre-war years there were few more controversial subjects than that of the carrier-based aircraft. The flight deck of an aircraft carrier imposed certain strict limitations on shipboard aircraft. The carrier aircraft could only be so big and so heavy. It had to possess wing folding mechanism, flotation equipment, arrester gear and other specialized items, and it had become an accepted fact that the shipboard aircraft could not compete on even terms with its land-based counterparts on the score of performance and load-carrying ability.

The mid-'thirties witnessed the infancy of the shipboard monoplane, but most naval pilots were conventionalists and to them the biplane represented the *conventional* in carrier-based aircraft; they were reluctant to relinquish the tried and tested biplane formula, despite its inherent shortcomings from the performance standpoint, in favour of the monoplane with its higher loadings and seemingly insoluble deck operating problems. The carrier deck was thus to become the last refuge of the combat biplane. Nevertheless, the year 1937 was to see the delivery of the first Vought SB2U-1 and Northrop BT-1 shipboard dive-bomber monoplanes to the U.S. Navy; it was to see the débuts of prototypes of the Blackburn Skua and Aichi D3A1 shipboard dive-bomber monoplanes in Britain and Japan respectively and Grumman's XF4F-1 shipboard fighter monoplane in the U.S.A., and it was to see the initiation of *Programme Technique* A47 in France.

A47, issued by the *Service Technique de l'Aéronautique* at the behest of the French Admiralty, did not merely call for a shipboard *monoplane*, but a *twin-engined* shipboard monoplane, and although events were to prevent either one of the aircraft evolved to meet this requirement from attaining production or service, time was to prove how remarkably far-sighted was *Programme Technique* A47.

*The C.A.O.*600 *No.* 01 *at Istres in April* 1940. *This aircraft was flown for* 35 *hours at Istres before the test programme was halted on June* 25*th*





The C.A.O.600 No. 01 illustrated above did not feature the folding outer wing panels embodied by the second prototype, construction of which was abandoned

In 1937, the French Navy possessed one carrier, the *Béarn*, aboard which were embarked obsolete Levasseur PL 7 torpedo-carrying biplanes and Levasseur PL 101 reconnaissance biplanes. Preparations were in hand for the construction of two new carriers, the *Joffre* and the *Painlevé*, and it was to provide these new carriers with a modern aircraft capable of fulfilling the reconnaissance, torpedo-bombing, level bombing and smoke-screen-laying roles that *Programme Technique* A47 was established.

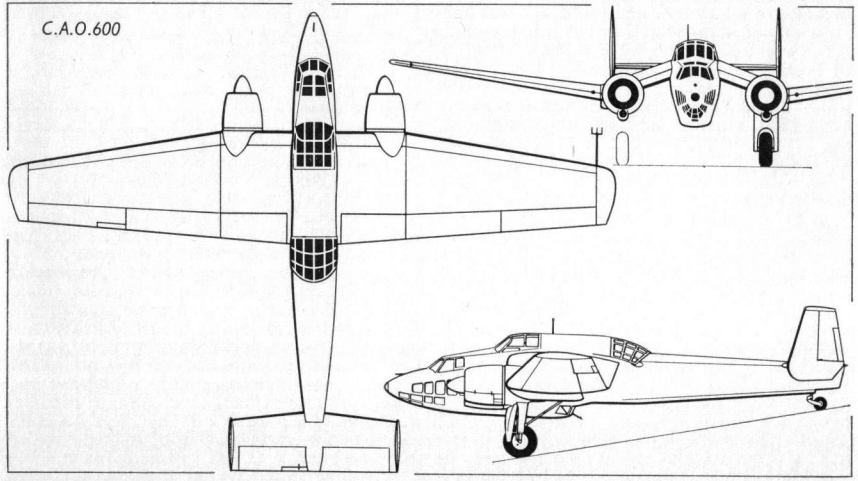
The requirement called for a twin-engined shipboard aircraft with a maximum speed superior to 186 m.p.h. and a loaded weight of between 8,820 and 11,025 lb. For the reconnaissance mission it had to accommodate three crew members and carry two 165-lb. G2 bombs; as a torpedo-bomber it had to carry a crew of two and a 1,433-lb. torpedo, and as a level bomber a crew of three and four Type I2 bombs of 330 lb., two Type K bombs of 496 lb., or one Type P bomb of 992 lb. had to be carried. Defensive armament had to comprise one fixed 7.5-mm. Darne machine gun and two similar weapons on flexible mountings, and endurance had to range from 3.5 hours at 155 m.p.h. as a torpedo-bomber to 6 hours at an altitude of 3,280 ft. for the reconnaissance mission.

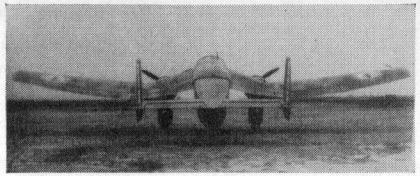
Two designs were evolved to meet the requirement, the C.A.O.600 and the Dewoitine D.750. The former was designed under the direction of M. Pillon, chief of the naval aircraft design department of the Société Nationale de Constructions Aéronautiques de l'Ouest (SNCAO), and two prototypes were ordered by the *Ministère de l'Air* on behalf of the *Ministère de la Marine* on June 15, 1939, construction being undertaken at Issy-Les Moulineaux.

The first prototype, the **C.A.O.600 No. 01,**

was assembled at Villacoublay where the first flight test took place on March 21, 1940 with the SNCAO chief test pilot, Pierre Nadot, at the controls. Powered by two Gnôme-Rhône 14M air-cooled radials, the C.A.O.600 was aesthetically an extremely unattractive aircraft. Of all-metal construction, the aircraft featured an inverted gull wing mounted in high-mid position, the GR 14M engines, which drove Ratier controllable-pitch three-blade electric airscrews of 8 ft. 10¼ in. diameter, being mounted at the extremities of the sharply-anhedralled wing centre section, their nacelles housing the main members of the rearward-retracting Messier undercarriage. The wing was of single box-spar construction, the outer panels swivelling to fold aft, and carrying fabric-covered ailerons and flaps. The stressed-skin fuselage was unusual in featuring two stepped windscreens, the forward windscreen being intended for the navigator-bombardier and the aft windscreen for the pilot. The pilot was seated to port with a catwalk to starboard communicating between the navigator-bombardier's position in the extreme nose and that of the radio-operator-gunner aft.

The C.A.O.600 No. 01 did not feature folding outer wing panels which were to be employed by **C.A.O.600 No. 02**, and the first prototype was flown from Villacoublay to Istres on March 31, 1940 where the manu-





This rear view of the C.A.O.600 No. 01 reveals clearly the inverted gull configuration of the wings

facturer's test programme was to be conducted. Some 35 flying hours had been completed by June 25th when the test programme was brought to a halt, and the prototype was subsequently dismantled and stored at Istres where it was eventually scrapped after the occupation of France's southern zone in November 1942. The second prototype was nearing completion when German forces reached the Paris area in June 1940, but was subsequently abandoned.

C.A.O.600 SPECIFICATION

Type: *Two-seat Shipboard Torpedo-bomber and Three-seat Reconnaissance-bomber.* **Power Plants:** *Two Gnôme-Rhône 14M 14-cylinder radial air-cooled engines each rated at 680 h.p. for take-off.* **Armament:** (*Defensive*) *One fixed forward-firing 7.5-mm. Darne machine gun and single 7·5-mm. Darne aft-firing machine guns on flexible mountings in dorsal and ventral positions.* (*Offensive*) *One 1,433-lb. torpedo or four 330-lb., two 496-lb., or one 992-lb. bomb, or* (*reconnaissance mission*), *two 165-lb. bombs.* **Performance:** *Maximum speed, 236 m.p.h. at 4,920 ft.; economical cruising, 186 m.p.h. at 3,280 ft.; range* (*with torpedo*), *560 mls.; maximum range* (*reconnaissance mission*), *995 mls. at 3,280 ft.* **Weights:** *Loaded, 10,362 lb.* **Dimensions:** *Span, 54 ft. 1½ in.; length, 40 ft. 8⅛ in.*

C.A.O.700

FRANCE

The last few years of peace preceding World War II witnessed the beginnings of a metamorphosis in heavy bomber design. The belief that a machine beautiful as an aeroplane was ridiculous as a weapon had died as the appreciation of the value of aerodynamic cleanliness to performance had grown, but building a measure of grace into a multi-engined strategic bomber, despite the handicaps imposed by defensive turrets and bomb-bays, demanded a measure of ingenuity on the part of the designer. The French aircraft industry was slower than the industries of some other countries in adapting the latest design techniques to the largest category of bombing aircraft, its tardiness being due to a combination of short-sightedness on the part of those responsible for framing official requirements and economic factors rather than any inability on the part of its designers.

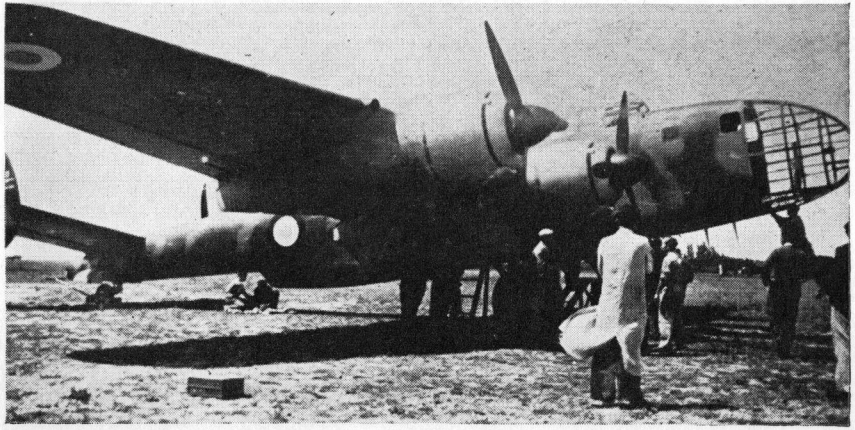
When, at the beginning of 1937, *Programme Technique* A20 calling for a modern multi-engined five-seat heavy bomber *was* finally formulated, it resulted in a pair of prototypes comparing favourably from both performance and aesthetic viewpoints with any aircraft in their category and generation. But time was not on the side of the French aircraft industry nor the *Armée de l'Air* that was to have operated these new heavies. Indeed, one of the pair, the C.A.O.700, missed flying at all by a matter of minutes. On June 24, 1940, the

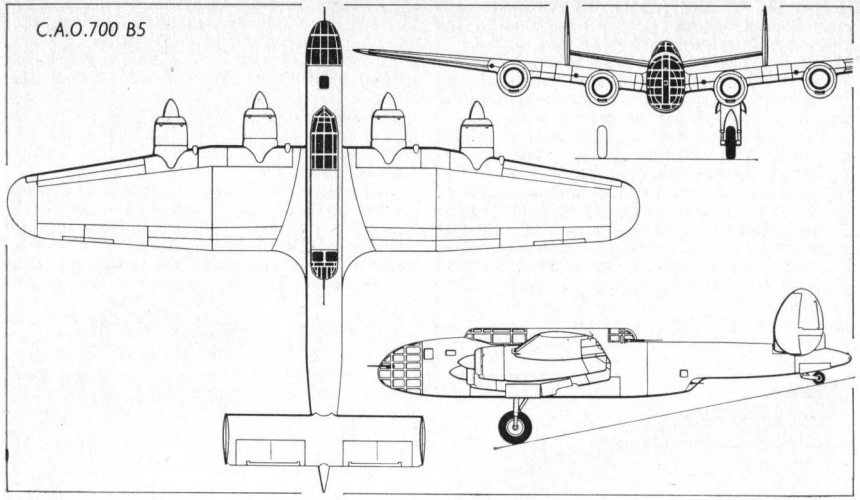
prototype of this promising bomber was actually taxying to its take-off point on the runway at Istres where it was about to make its initial flight when news was received that the Armistice terms forbade further flights by French aircraft, and the crew of the C.A.O.700 was ordered to return to dispersal.

The C.A.O.700 was undoubtedly the least attractive aesthetically of the bombers developed to meet the requirements of A20, this being due in part to the fact that, in order to design the aircraft as rapidly as possible, the Saint-Nazaire design team of the Société Nationale de Constructions Aéronautiques de l'Ouest (SNCAO), the former aircraft division of the Ateliers et Chantiers de la Loire, elected to use virtually unchanged the fuselage of the Loire-Nieuport 10 twin-engined float seaplane already under design development for the *Aéronavale*. This fuselage was adapted to an entirely new wing of NACA 23010-15 profile carrying four Gnôme-Rhône 14N 49 clockwise-rotating engines identical to that installed in the starboard nacelle of the LeO 451 and complete with Mercier cowling and Ratier-1634 airscrew.

The wing was a metal stressed-skin two-spar torsion-box structure, a weapon bay within the torsion box between the fuselage and inboard engines nacelles housing a pair of 496-lb. bombs on each side, and the main fuel tanks being accommodated between the engine

The C.A.O.700 B5 No. 01 heavy bomber photographed at Istres in June 1940 shortly before initial flight trials were scheduled to commence





nacelles and immediately outboard of the outer nacelles, these being supplemented by additional tanks in the outer nacelles themselves. The leading-edge slats on the outboard wing panels and the double-slotted flaps were hydraulically operated.

The rectangular-section fuselage was also of metal stressed-skin construction, with tandem dual controls on the port side for pilot and co-pilot, a bombardier-navigator's compartment in the extreme nose with a Bronzavia-D30 bomb sight and a single 7.5-mm. MAC 1934 machine gun on a flexible mounting, a dorsal gunner with a 20-mm. Hispano-Suiza cannon in a SAMM-AB15H power-operated turret above and aft of the wing trailing edge, and a compartment for the radio-operator below and further aft, with SARAM-3.10 R/T and LMT-RC5b D/F equipment, and a pair of 7.5-mm. guns on a SAMM-AB22 flexible mounting firing from the ventral step. The main bomb-bay was more than 19 ft. in length, and further bomb stowage was provided aft of the flight deck to port, a catwalk running fore and aft to starboard.

The components of the **C.A.O.700 No. 01** were ready for assembly when German forces approached Saint-Nazaire in June 1940, and these were hastily transported by rail to Istres where final assembly was completed and, after

ground tests, the prototype readied for its first flight which was scheduled for June 24th, but which, as already recounted, was frustrated by a matter of minutes.

When the Armistice terminated further work on the C.A.O.700, development of several variants of the basic design were in hand, including the **C.A.O.700M**, the "M" suffix indicating *Marine*. Intended for long-range maritime reconnaissance, the C.A.O.700M was expected to offer an endurance of 10 hr. 50 min. with two torpedoes at an average speed of 173 m.p.h., 15 hr. 30 min. without torpedoes at the same average speed, or 18 hr. without torpedoes and cruising at 138 m.p.h. In September 1939, design work was initiated on the **C.A.O.710** heavy bomber which, retaining the basic C.A.O.700 fuselage, was to have been powered by four 1,320 h.p. Gnôme-Rhône 14R 4/5 two-stage engines, the larger-diameter airscrews of which would have dictated wider spacing of the engine nacelles and increases in wing span and area to 88 ft. 11 in. and 1,018.265 sq. ft. Loaded weight was estimated at 44,092 lb. and maximum speed at 398 m.p.h.

Further developments of the basic design included the **C.A.O.720**, a pressurized 15-passenger commercial transport which was 60 per cent complete in December 1940 when the German authorities ordered the abandoning of further work on this type in order that the factory at Saint-Nazaire could be devoted exclusively to the production of the Arado Ar 196 floatplane.

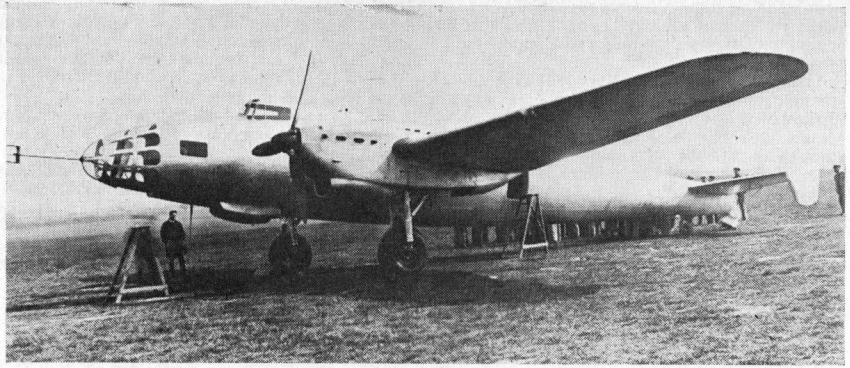
C.A.O.700 B5 SPECIFICATION

Type: *Five-seat Heavy Bomber.* **Power Plants:** *Four Gnôme-Rhône* 14*N* 49 14-*cylinder radial air-cooled engines each rated at* 1,140 *h.p. for take-off and* 1,035 *h.p. at* 15,750 *ft.* **Armament:** (*Defensive*) *One* 7.5-*mm. MAC* 1934 *machine gun on flexible mounting in nose with* 600 *rounds, one* 20-*mm. Hispano-Suiza cannon with* 210 *rounds in power-operated dorsal turret, and two* 7.5-*mm. MAC* 1934 *machine guns on flexible mounting with* 500 *r.p.g. in ventral step.* **Performance:** (*Manufacturer's estimates*) *Maximum speed,* 335 *m.p.h. at* 17,385 *ft.,* 255 *m.p.h. at sea level; economical cruising speed,* 200 *m.p.h. at* 16,400 *ft.* **Weights:** *Empty,* 25,111 *lb.; loaded,* 39,835 *lb.* **Dimensions:** *Span,* 82 *ft.* 0¼ *in.; length,* 61 *ft.* 10 *in.; wing area,* 947.223 *sq. ft.*

CENTRE NC 150 FRANCE

Bomb-aiming devices were, in the years immediately preceding World War II, at a relatively primitive stage of development, and it was an accepted fact that the higher a bomber flew the smaller its chance of successfully hitting its target became. Nevertheless, advances in fighter performance and armament had been such that some authorities had come to subscribe to the theory that the bombing of heavily-defended strategic targets could well become impracticable unless the bombers operated at extreme altitudes which could afford them virtual immunity to anti-aircraft fire and fighter interception.

Relatively little was known about flying for prolonged periods at very great altitudes, but in France the Farman company at Billancourt had undertaken much pioneering work with the F 1000 high-altitude research monoplane and with the supercharing of aero engines, and



The NC 150.01 *high-altitude medium bomber prototype photographed at Toussus-le-Noble on May* 11, 1939 *immediately before its initial flight test. The NC* 150 *was later to be looked upon as an insurance against any delays in production deliveries of the LeO* 451 *and Amiot* 350 *series bombers*

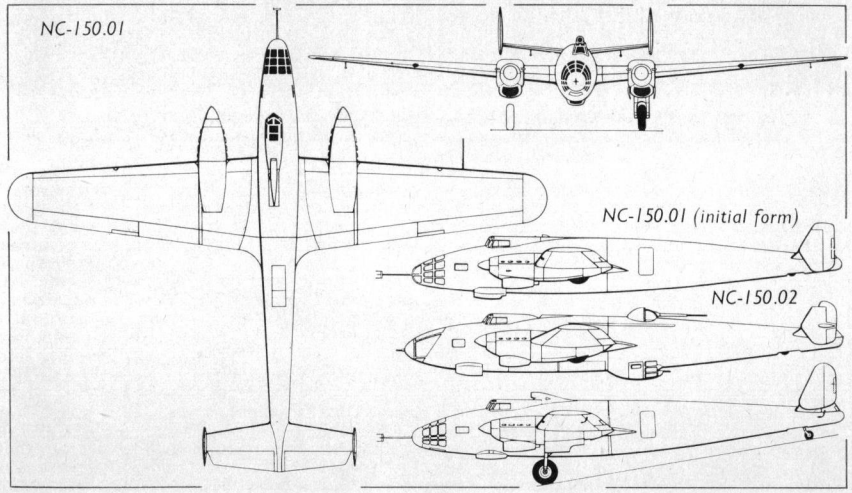
when the Société Nationale de Constructions Aéronautiques du Centre (SNCAC) was formed in 1936 by the fusion of the Farman and Hanriot companies, the former Farman design team, under the direction of Marcel Roca, continued this line of development with the aim of evolving an efficient high-altitude bomber.

Late in 1937, Marcel Roca's team had initiated design studies for a refined version of the NC 223 bomber which, with a semi-pressurized cabin, was intended to serve as a mailplane over the North Atlantic route, flying at altitudes of the order of 26,000 ft. Development of this aircraft, the NC 223.4, had been initiated at the behest of the Société Air France Transatlantique which had been created on June 18, 1937, and although cabin pressurization was abandoned at an early development stage, in 1938 studies were launched of two bombers which would, it was envisaged, eventually embody fully pressurized cabins. The larger of the two bombers, the NC 140, was intended to employ the wings, tail surfaces and undercarriage of the NC 223.3 bomber and NC 223.4 mailplane, a similar arrangement of four Hispano-Suiza 12Y engines paired in two nacelles, and a new circular section pressurized fuselage, but detail design was shelved in favour of a smaller bomber, the **NC 150**, construction of which began in 1938 at Billancourt.

As pressure cabin development was still in its infancy and pending the results of trials with the NC 130 research aircraft which was being built specifically for testing the pressure

cabin being developed by the SNCAC, it was decided to build the first two NC 150 prototypes without the pressure cabin, incorporating this feature in the third prototype, and in view of the ominous situation developing in Europe non-strategic materials were selected for as much of the structure as possible.

The first prototype, the **NC 150.01**, was completed in the early spring of 1939, assembled at Toussus-le-Noble, and flown from there for the first time on May 11th. The aircraft was powered by two Hispano-Suiza 12Y 32/33 12-cylinder liquid-cooled engines, the 955 h.p. rating of which was raised from 7,380 ft. to 29,530 ft. by means of a single NC-Cl three-stage supercharger driven by a 690 h.p. Hispano-Suiza 12Xirs engine mounted above the bomb-bay and cooled by means of a scoop beneath the forward fuselage. The three-spar mid-mounted wing, which had a thickness/chord ratio decreasing from 20 per cent at the root to 14 per cent at the tip, comprised an all-metal centre section and outer panels of mixed construction with metal spars and wooden ribs, the whole covered by stressed plywood and carrying metal-framed fabric-covered ailerons and hydraulically-operated metal split flaps. All fuel was housed in the wing centre section, with two 88 Imp. gal. tanks ahead of the centre spar and two 143

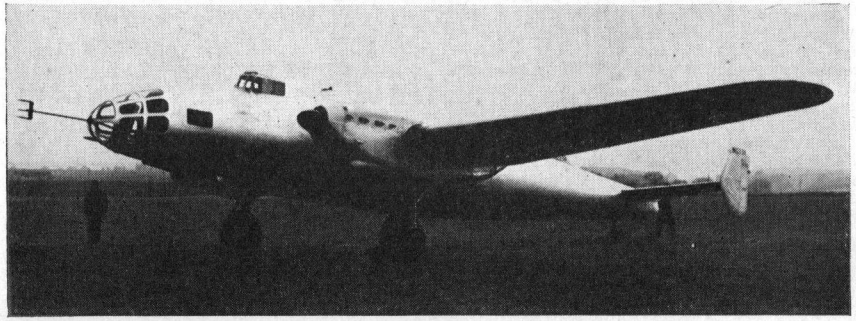


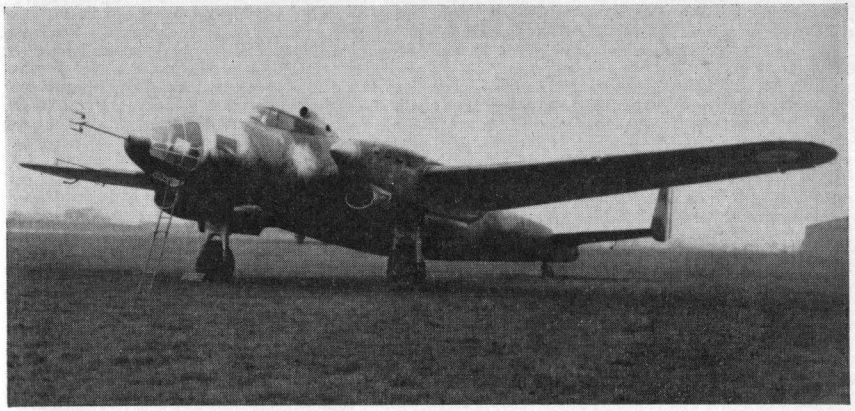
Imp. gal. tanks aft of the spar. The oval-section fuselage was of mixed construction and comprised wooden forward and aft sections covered by stressed plywood and an all-metal centre section built integral with the wing centre section. The fins, rudders and tailplane were of wooden construction with plywood skinning, the elevators being metal-framed with fabric skinning.

In June 1939, after the fifth flight, the narrow annular intakes aft of the airscrew spinners were deleted and enlarged spinners fitted, and after the eighth flight in July the intake for the NC-C1 supercharger above and aft of the cockpit was enlarged and extended forward. From September 22nd, the NC 150.01 flew with a redesigned glazed nose, but the stability of the aircraft was not all that might be desired and the tail was subjected to some buffet, and therefore a wedge in the form of an elongated triangle was inserted between the centre and aft fuselage sections, this raising the lower aft fuselage contour, the tailplane being raised 1 ft. 3¾ in. in relation to the line of flight. Simultaneously the endplate vertical tail surfaces were redesigned, and with these modifications the aircraft made its 32nd flight on October 19th. Subsequently, a larger-capacity NC-C2 supercharger was installed, and on the 35th flight the NC 150.01 attained a cruising speed of 292 m.p.h. at an altitude of 25,260 ft.

By this time, however, the *Ministère de l'Air* was looking upon the NC 150 as an insurance against any serious reductions in the production of the LeO 451 and the Amiot 350 Series bombers through shortages of light alloys, and the SNCAC was ordered to postpone power plant development trials so that the flying qualities of the prototype could be evaluated by the *Centre d'Essais du Matériel Aérien*, or CEMA, and accordingly, on December 27th, the NC 150.01 was flown from Toussus-le-Noble to Villacoublay and, on January 2, 1940, from there to Orléans-Bricy for the

The NC 150.01 *seen below in its initial form. In June* 1939, *after its fifth flight, the prototype had the narrow annular intakes immediately aft of the spinners deleted, enlarged spinners being fitted*





The NC 150.01 *photographed at Toussus-le-Noble on December* 19, 1939, *immediately prior to its* 32*nd flight, this being the first flight test with raised aft fuselage and redesigned vertical tail surfaces*

official trials. Further CEMA tests were undertaken at Marignane where the aircraft had been flown on February 23rd, and with the completion of these on March 21st, the aircraft was flown on that same day to the SNCAC at Bourges for the completion of power plant development.

At Bourges, the NC 150.01 received HS 12Y engines with a reduction gear ratio of 1 : 2 as compared with the 2 : 3 of the existing engines in order to eradicate some trouble resulting from excessively high airscrew tip speeds, and with these power plants resumed flight testing on June 14, 1940. Mountings for HS 12Y engines driving individual NC-C1 superchargers had been designed at the SNCAC's Fourchambault plant, although this modification was destined never to be made. The contract placed by the *Ministère de l'Air* for the NC 150.01 and 02 on April 24, 1939, only a little more than two weeks before the initial flight of the first prototype, stipulated that the NC 150.01 be completed without armament, but that the **NC 150.02** have full military equipment. Several design changes had been introduced on the NC 150.02 as a result of flight testing of its predecessor, these including an increase in wing root chord from 13 ft. 1½in. to 14 ft. 1¼ in., an increase in taper on the wing outboard panel leading edges, and a slight lengthening of the fuselage from 57 ft. 9 in. to 58 ft. 4¾ in. Armament was to comprise a 20-mm. Hispano Suiza 404 cannon on a power-operated dorsal mounting, a

ventral gondola housing a 7.5-mm. MAC 1934 machine gun on a flexible mount, and a similar weapon for the bombardier-navigator in the extreme nose.

The NC 150.02 was nearing completion at Fourchambault in April 1940. Previously it had been intended that the second aircraft would be powered by similar HS 12Y 32/33 engines as those of the NC 150.01, and an NC-C2 supercharger, and with full military equipment it had been estimated that range and maximum speed would be 1,367 miles and 360 m.p.h. at 26,250 ft. respectively. However, such had been the success of the CEMA trials with the NC 150.01, and as the slow tempo of deliveries of the LeO 451 and Amiot 350 series had rendered urgent the production of bomber employing a large proportion of non-strategic materials in its construction, the SNCAC was instructed to abandon the auxiliary engine arrangement and adapt the bomber to take either two Hispano-Suiza 12Y engines with Brown-Boveri turbo-superchargers, or two Pratt & Whitney R-2800 SlA4-G Double Wasp 18-cylinder two-row radials with two-speed superchargers, the latter power plant offering 1,850 h.p. for take-off and 1,450 h.p. (high blower) at 13,000 ft. With the Hispano-Suiza engines the bomber would have been designated **NC 152** and with the Double Wasps it would have become the **NC 153**, but the Armistice prevented the development of these models, and also the completion of a third prototype, the **NC 151.01**, which had originally been considered as the definitive version of the basic design, featuring a pressure cabin for the four crew members in the forward fuselage. This aircraft was under construction at Fourchambault when development was terminated.

With the commencement of the German offensive, the NC 150.01 was evacuated from Bourges to the nearby auxiliary airfield of Lissay-Lochy to avoid *Luftwaffe* bombing. From here the aircraft was flown to Cognac on June 13th from where, six days later, it was flown to Bordeaux-Mérignac. The modifications planned after the completion of the CEMA trials had not been undertaken, and no further flight tests were performed.

CENTRE NC 150 SPECIFICATION

Type: *Four-seat High-altitude Medium Bomber.* **Power Plants:** *Two Hispano-Suiza* 12*Y* 32/33 12-*cylinder liquid-cooled engines each rated at* 960 *h.p. and supercharged by NC-C2 supercharged driven by* 690 *h.p. Hispano-Suiza Xirs* 12-*cylinder liquid-cooled auxiliary engine to provide* 955 *h.p. up to* 29,530 *ft.* **Armament:** (*Proposed for NC* 150.02) *One* 20-*mm. Hispano-Suiza* 404 *cannon on power-operated flexible dorsal mounting, one* 7.5-*mm. MAC* 1934 *machine gun on flexible mounting in nose, and one MAC* 1934 *gun on flexible ventral mounting.* (*Offensive*) *Six* 441-*lb., eight* 220-*lb.,* 24 110-*lb., or* 96 22-*lb. bombs.* **Performance:** (*NC* 150.01) *Maximum speed,* 373 *m.p.h. at* 26,250 *ft.; long-range cruising speed,* 317 *m.p.h. at* 26,250 *ft.; maximum range,* 1,367 *mls.; time to* 26,250 *ft.,* 19 *min.* 7 *sec.; service ceiling,* 37,730 *ft.; single-engine ceiling,* 27,060 *ft.* **Weights:** (*NC* 150.01) *Empty,* 17,048 *lb.; loaded,* 22,216 *lb.* **Dimensions:** (*NC* 150.01) *Span,* 71 *ft.* 9½ *in.; length,* 57 *ft.* 9 *in.; wing area,* 657.674 *sq. ft.*

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